SECTION 4
ENVIRONMENTAL CONSEQUENCES

This section addresses the direct, indirect and cumulative effects of the No Action Alternative and the three action alternatives as they affect the 13 resource areas. These resource issues were raised during the scoping and consultation process. This section is organized by resource issues and provides the scientific, analytical, and technical basis for assessing the effects on those resources.

Direct impacts and indirect are those that occur primarily within RGCP. These impacts occur over a 20 year implementation period. While some effects are negative or adverse, the long term effects are beneficial. The environmental consequences discussion combines both kinds of effects.

Cumulative impacts occur when the USIBWC action has an incremental impact when analyzed in light of "past, present, and reasonable foreseeable future actions regardless who causes or is responsible for such actions." The USIBWC actions under consideration are unique and confined locally to the RGCP

Most of the other actions are planning actions that might influence river conditions and have been considered from a general perspective. Planning functions such as recreations areas permitted by the USIBWC were considered as ongoing actions as part of the RGCP project.

Mitigation has been addressed in a subsection by resource areas. Most of the actions have been included as part of the project activities for implementation.

Evaluation criteria were identified for resource areas to assess potential effects of environmental measures included under each river management alternative. Effects evaluation criteria were selected by the USIBWC and support technical team taking into consideration issues discussed during the Environmental Impact Statement scoping and alternatives formulation meetings.

For each of the resource areas evaluated, the following sequence of presentation is used:

- Resource and evaluation criteria,
- Method of analysis,
- Comparative summary of effects for all alternatives, and
- Discussion of effects by individual alternative.

Potential cumulative effects associated with other projects and pertinent activities and mitigation measures, are presented in separate subsections following the resources impact analysis.

4.1 WATER RESOURCES

The effects of the alternatives on water resources along the RGCP were evaluated using the following evaluation criteria:

- Changes in water consumption;
- Water delivery efficiency; and
- Effects on water quality.

4.1.1 Method of Analysis

Water consumption rates were applied on an annual basis to the acreage for each measure. Table 4.1-1 presents 2001 water consumption estimates for various types of plant coverage. Applicable 2001 data for the Rio Grande Basin were obtained from USBR AWARDS System/ET Tool Box Project. Table 4.1-2 lists for each individual measure assumptions used in the calculation of water consumption.

Changes in delivery efficiency and water quality were both evaluated in qualitative terms. Assumptions for changes in water delivery efficiency are listed in Table 4.1-2.

Table 4.1-1 Water Consumption Estimates for Rio Grande Vegetation

Type of Coverage	Annual Water Consumption* (ac-ft/ac)	Start Date	Term Date	Evapotrans-piration (inches)	Annual Forecast (inches)
Pasture grass	4.01	Mar 15	Oct 20	41.3	48
Miscellaneous grass	4.63	Apr 05	Oct 20	47.7	56
Cottonwood	3.48	Apr 05	Nov 21	30.4	42
Salt cedar	4.96	Apr 05	Nov 21	49.5	59
Riparian wood/shrub	5.35	Apr 05	Nov 21	46.7	64
Open water	8.48	Jan 01	Dec 31	73.3	102
Marsh	8.85	Jan 01	Dec 31	76.5	106

* Annual forecast expressed in feet. Data for 2001 from USBR Rio Grande Basin AWARDS System and ET Toolbox Project (*www.usbr.gov/pmts/rivers/awards/Nm/riogrande.html*)

4.1.2 Summary of Potential Effects

Table 4.1-3 presents a comparative summary of potential effects of river management alternatives on water resources.

4.1.3 No Action Alternative

No effects are anticipated on water consumption, water delivery or water quality as current practices are maintained.

Table 4.1-2 Assumptions for Water Consumption Estimates and Changes in Water Delivery Efficiency

Measure	Assumptions for Water Consumption Estimates	Assumptions for Changes in Water Delivery Efficiency
Levee rehabilitation	No effect on water consumption.	No effects on water delivery.
Modify grazing practices	No net change for uplands. In the floodway, managed grasslands replace grazed areas (4.63 – 4.01 = 0.62 ft/yr increase).	No effect on water delivery (potential positive effect by reduction in erosion and sediment load).
Modified grassland management in floodway	Managed grasslands replace currently mowed areas (4.63 – 4.01 = 0.62 ft/yr increase).	No effect on water delivery (potential positive effect by reduction in erosion and sediment load).
Plant woody native vegetation	Tree planting areas replace both currently mowed areas (5.35 - 4.01 = 1.34 ft/yr increase), and salt cedar areas (4.96 – 3.48 = 1.48 ft/yr reduction)	Potential bank stabilization (reduced sediment load) by riparian corridor and increase in debris in the pilot channel (interference with irrigation infrastructure).
Enhance existing bosques	No water consumption increase as existing bosques are maintained.	No effects on water deliveries as existing bosques are maintained.
Bank shavedowns	Bosques replace both currently mowed areas (5.35 - 4.01 = 1.34 ft/yr increase), and salt cedar areas (4.96 – 3.48 = 1.48 ft/yr reduction)	Potential sediment load changes (reduction by vegetative bank stabilization, and short-term increase by soil mobilization). Short-term increase in debris into the pilot channel.
Open former meanders	Open water replaces both currently mowed areas (8.48 – 4.01 = 4.47 ft/yr increase) and salt cedar bosque (8.48 – 4.96 = 3.52 ft/yr increase).	Minimum effect on water delivery as meanders would be reopened downstream to create backwaters, not as flow-through channels.
Modify dredging at arroyos	No net increase in water surface area exposed to evaporation.	No effect as dredging Is required to prevent pilot channel obstructions.
Controlled peak flows	As a conservative scenario, consumption of entire volume of water released (assuming no downstream utilization for irrigation).	Controlled releases would cause overbank flows and potential short-term increase in sediment and debris into the pilot channel.
Conservation easements	No increase in current water consumption for remnant bosques (no intervention), or agricultural lands (managed grasslands replace cropped areas).	No effect on water delivery.

Table 4.1-3 Summary of Potential Effects on Water Resources

Evaluation Criteria	No Action Alternative	Flood Control Improvement Alternative	Integrated USIBWC Land Management Alternative	Targeted River Restoration Alternative
Change in water consumption relative to 645,000 ac-ft annual diversions along the RGCP	No effect	0.17%	0.35%	1.55%
Effect on water delivery efficiency	No effect	No effect	Potential adverse short-term effects; long-term improvement	Potential adverse short-term effects; long-term improvement
Effect on water quality	No effect	Potential adverse short-term effects; long-term improvement	Potential adverse short-term effects; long-term improvement	Potential adverse short-term effects; long-term improvement

4.1.4 Flood Control Improvement Alternative

Water consumption would be increased by converting 1,739 acres of grazing areas in the floodway into an improved riparian community. The estimated change would be 1,078 ac-ft/yr assuming a rate increase of 0.62 ft/yr. This amount is equivalent to 0.17 percent of the annual combined diversions of Rio Grande Project water at Leasburg, Mesilla and American Dams (645,000 ac-ft/year).

No effects on water delivery efficiency are anticipated as a result of the levee system rehabilitation, or changes in grazing leases in uplands.

Water quality could decrease in terms of total suspended solids during construction, but it would improve in the long-term by a reduced sediment load and lower nutrient input from grazing areas with improved vegetative cover.

4.1.5 Integrated USIBWC Land Management Alternative

Water Consumption

Potential changes in water consumption are listed in Table 4.1-4. The potentially more significant changes in water consumption would be in the change of grazing leases and no-mow areas to managed native vegetation grasslands, each measure representing approximately 0.17 percent of the combined diverted water from Leasburg, Mesilla and American Dams. The net increase for tree planting areas and stream bank shavedowns, taking into account the required removal of salt cedar, is approximately 0.02 percent of the combined annual diversion value. On an annual basis, the potential water use for the Integrated USIBWC Land Management Alternative would represent, at the completion of the 20-year implementation period, approximately 0.35 percent of the combined water diversion from Leasburg, Mesilla and American Dams (Table 4.1-4).

Table 4.1-4 Water Consumption Estimates for the Integrated USIBWC Land Management Alternative

Measure	Area (acres)	Unit Rate (ac-ft/yr)	Consumption at Full Implementation (ac-ft/yr)	Use Relative to 645,000 ac-ft/yr of Diverted Water*
Modified grazing leases				
Uplands (50.8%)	1,805	0.00	0.0	0.00%
Floodway (49.2%)	1,747	0.62	1,083	0.17%
Native grasslands	1641	0.62	1,017	0.16%
Tree planting areas				
Currently mowed areas	146.0	1.34	196	0.03%
Salt cedar areas	77.0	-1.48	-114.0	-0.02%
Stream bank shavedowns				
Currently mowed areas	74.0	1.34	99	0.02%
Salt cedar areas	53.0	-1.48	-78.4	-0.01%
		Total Estimate	**2,203**	**0.34%**

* An average diversion of 645,000 ac-ft/yr was based on a combined average of 890 cfs along the RGCP (181 cfs at Leasburg Dam, 312 cfs at Mesilla Dam, and 397 cfs at American Dam; data from Figure 3-3).

Water Delivery and Water Quality

Development of riparian vegetation along the stream banks is likely to have a positive long-term effect on cottonwoods and willows, once established, and would provide stability to the stream bank. In a technical evaluation of the RGCP functionality, vegetative stream bank stabilization with sand bar willow was recommended as a multi-objective technique for bank protection, sediment input reduction, and improved riparian habitat along the RGCP (USACE 1996). The evaluation recommended vegetative stabilization for nearly four miles of stream banks, applied either individually or in combination with riprap or soft armoring technologies.

On the short-term, the bank preparation and seedling establishment could result in a greater release of plant debris into the channel and the need for additional channel maintenance. However, shavedown areas would be designed to provide backflooding and avoid creating free-flow channels over the vegetated area.

Soil preparation, prior to establishment of the vegetative cover, could result in short-term increases of sediment release into the river. This effect would not be considered significant in terms of water quality given that a potential sediment contribution from 127 acres of shavedowns areas would be negligible compared to the RGCP tributary watershed that extends over several hundred square miles. Water quality is likely to improve to some extent as a more extensive vegetative cover on the RGCP floodway and uplands improve erosion control and lessen nutrient release from grazing areas.

4.1.6 Targeted River Restoration Alternative

Water Consumption

Potential changes in water consumption are listed in Table 4.1-5. Excluding controlled water releases from Caballo Dam, the potential water consumption would be approximately 0.33 percent of the combined diversions at Leasburg, Mesilla and American Dams. This consumption is similar to the estimated value for the Integrated USIBWC Land Management Alternative, considering both alternatives at full implementation. Controlled water releases would increase water consumption to approximately 1.47 percent of the water diversions along the RGCP.

Water consumption associated with controlled releases from Caballo Dam was estimated as a function of volume released, not of the overbank flow surface area. Appendix F describes the assumptions and basis for the calculation. The potential release calculation took into consideration that 5,000 cfs is the physical limitation of the Caballo Dam outlet work discharge structure, as well as the design value for containment of the 100-year flood in the upper reach of the RGCP. With a typical average irrigation release of 1,300 cfs for the main irrigation season, an additional 3,700 cfs above the average irrigation release would be required to reach the maximum discharge from Caballo Dam as determined by the outlet works capacity.

Table 4.1-5 Water Consumption Estimates for the Targeted River Restoration Alternative

Measure	Area (acres)	Unit Rate (ac-ft/yr)	Consumption at Full Implementation (ac-ft/yr)	Use Relative to 645,000 ac-ft/y of Diverted Water*
Modified grazing leases				
50.8% in uplands	1,805	0.00	0.0	0.00%
49.2% in the floodway	1,747	0.62	1,083	0.17%
Native grasslands	1,641	0.62	1,017	0.16%
Tree planting areas				
Currently mowed areas	124.0	1.34	166	0.03%
Salt cedar areas	65.0	-1.48	-96.2	-0.01%
Open former meanders				
Currently mowed areas	54.0	4.47	241	0.04%
Salt cedar areas	88.0	3.52	-310	-0.05%
Controlled peak flows**	516	n/a	7,336	1.14%
Total Estimate			9,461	1.47%

* Average diversion of 645,000 ac-ft/yr based on a combined average of 890 cfs along the RGCP (181 cfs at Leasburg Dam, 312 cfs at Mesilla Dam, and 397 cfs at American Dam; data from Figure 3-3).

** Assumes a single 3,700 cfs discharge above average irrigation flows during the early irrigation season. The controlled released would be limited to a maximum of 24 hours (Appendix F).

To estimate the potential extent and duration of controlled releases from Caballo Dam, it was assumed that overbank flows would be induced during the early irrigation season, the most suitable for cottonwood establishment (Crawford *et al.*, 1999). For water consumption estimates, a release period up to 24 hours was assumed to increase soil moisture by overbank flooding and ponding (3,700 cfs over one day, or 7,336 ac-ft per year). Micro-irrigation could be used in subsequent months to support seedling development. Micro-irrigation was effective in cottonwood seedling establishment in Middle Rio Grande arid floodplains during tests conducted by the Rocky Mountain Research Station of the NRCS (Dreesen *et al.*, 1999).

It is anticipated that the maximum Caballo Dam discharge value would be reached by the end of a 20-year implementation period by gradually increasing releases of smaller magnitude. Any increase in water releases over irrigation flows assumes that extended monitoring would indicate that:

- Releases are an ecologically sound and effective approach to support development of the riparian corridor along the RGCP in relation to site-specific techniques such as shavedowns, planting, and seedling development by micro-irrigation.
- Enough water rights are acquired for the releases, and the releases do not to interfere with irrigation water delivery.
- Releases are safe to downstream properties, and agreements are reached for any required conservation easements in areas where induced water releases could extend beyond the ROW.

Water Delivery and Water Quality

Similarly to the Integrated USIBWC Land Management Alternative the development of riparian vegetation along the stream banks is likely to have a long-term positive effect as cottonwood and willows, once established, would provide stability to the stream bank. On the short-term, bank preparation and seedling establishment could result in a greater release of plant debris into the channel and the need for additional channel maintenance.

Soil preparation, prior to establishment of the vegetative cover could result in short-term increases of sediment release into the river. This effect would not be considered significant in terms of water quality, given that a potential sediment contribution from 127 acres of shavedowns areas would be negligible compared to the RGCP tributary watershed that extends over several hundred square miles. Water quality is likely to improve to some extent, as a more extensive vegetative cover on the RGCP floodway and uplands improve erosion control and nutrient release from grazing areas.

4.2 FLOOD CONTROL

Effects on flood control for all alternatives along the RGCP were evaluated using the following evaluation criteria:

- Increase in levee rehabilitation need, and
- Potential deficiencies as a percent of total levee system.

4.2.1 Method of Analysis

Analysis of Potential Levee System Deficiencies

A flood containment capacity analysis was performed using a hydraulic model to compare potential levee deficiencies under the No Action Alternative with those anticipated following implementation of environmental measures under the three action alternatives. The analysis emphasized the potential of extensive vegetation growth on the floodway. Simulations were performed using a HEC-2 model developed for the RGCP by the USACE (1996), converted to a HEC-RAS model (version 2) currently in use by the agency.

The HEC-RAS model, widely used in flood control studies, performs one-dimensional water surface profile calculations for steady-state conditions with gradual changes in flow due to inflows from tributaries and diversion outflows from the Rio Grande for irrigation. For locations where the assumption of steady state flows is valid, HEC-RAS solves the energy equation exclusive of any time-dependent terms. At locations where the flow is rapidly varied (at hydraulic structures such as bridges, culverts, and weirs), the program switches to the momentum equation or other empirical equations. HEC-RAS is a one-dimensional model (i.e., velocity components in directions other than the direction of flow are not accounted for) because the mathematical equations used are based on the premise that the total energy head is the same for all

points in a cross section. The program for this study does not have the capability of dealing with movable boundaries (i.e., sediment transport), or hydrograph routing, which would allow varying discharge rates to be calculated as the floodplain cross section varies. The topographic information available is limited to the digital elevation model, which the USACE produced for the 1996 study that typically extends only a very limited distance outside the ROW.

For the analysis of conditions under the No Action Alternative, hydraulic input data files and hydrologic data for the 100-year flood from the 1996 USACE study were used, as well as roughness coefficients applicable to the channel and floodway. Cross section geometry data were modified along a section of the El Paso RMU to incorporate the new Courchesne Bridge as planned by the Texas Department of Transportation.

To evaluate effects of the Integrated USIBWC Land Management and Targeted River Restoration alternatives, 100-year flood conditions were evaluated by modification of the 1996 USACE model to incorporate the effects of vegetation growth on the floodway. Extensive vegetation growth was initially simulated as part of the Alternatives Formulation Report completed in March 2001 (Parsons 2001a), but the extent of the vegetation cover was reduced as part of the alternatives reformulation (Parsons 2003a) when changes were made to the extent and locations of environmental measures as previously discussed in Subsection 2.1. The most extensive reductions in vegetation growth along the floodway were made in the El Paso, Las Cruces, and Lower Mesilla RMUs where a significant potential for increase in deficiencies was anticipated (nearly 75 percent of the increase of freeboard deficiencies as simulated in 2001 were located in the El Paso, Lower Mesilla, and Las Cruces RMUs). Vegetation growth along the floodway was simulated by increasing roughness coefficients (Manning's "n") from a typical value of 0.03 for mowed brush to 0.04 for agriculture, 0.05 for wetlands, 0.10 for shrubs, and 0.15 for trees. Appendix E lists the extent of changes in roughness coefficients included in the evaluation of alternatives for the Environmental Impact Statement as well as calculated water elevations.

4.2.2 Summary of Effects

Table 4.2-1 presents a comparative summary of potential effects of river management alternatives on flood control.

Table 4.2-1 Summary of Potential Effects on Flood Control

Evaluation Criteria	No Action Alternative	Flood Control Improvement Alternative	Integrated USIBWC Land Management Alternative	Targeted River Restoration Alternative
Need for levee improvements	60.1 miles	None	None	None
Average levee height increase for flood control improvement	Not applicable	24 inches	24.6 inches*	24.6 inches*

* Relative to the Flood Control Improvement Alternative the levee improvement program would require an average height increase (from an assumed average of 24 inches to 24.6 inches).

4.2.3 No Action Alternative

Under the No Action Alternative the risk of flooding for the 100-year flood would remain as currently quantified on the basis of the HEC-RAS simulations (Section 3.2).

4.2.4 Flood Control Improvement Alternative

The Flood Control Improvement Alternative would address potential deficiencies in the levee system by construction of 2.8 miles of floodwall in the Canutillo area, 6 miles of new earthen levees, and levee rehabilitation along 60.1 miles to increase freeboard to the minimum design value of 3 feet. This measure would provide the additional protection to life and public and private property beyond that already provided by the existing levee system and upstream flow regulation against an extremely high flood event induced by a storm with a 100-year recurrence period.

4.2.5 Integrated USIBWC Land Management Alternative

Benefits of an improved flood control system would be obtained under this alternative,. There is, however, a potential for increase in deficiencies due to increase vegetation growth along the floodway. Table 4.2-2 lists changes in levee rehabilitation estimates in the flood control system, as identified in the baseline conditions, compared to potential deficiencies that could result from riparian and floodway vegetation growth at the completion of the 20-year implementation period. The overall difference in estimates for rehabilitation is an increase of 2.29% relative to the baseline conditions. In terms of levee rehabilitation, an average increase of 0.55 inches would be required over the 2-foot assumption used for the flood control improvement alternative.

Table 4.2-2 Estimates of Levee Rehabilitation Needs for the Integrated USIBWC Land Management Alternative

River Management Unit	Estimates for the Alternative		Estimates for Baseline		Difference Versus Baseline	Increase In Rehabilitation Height (inches)*
	Miles	% of Levee System	Miles	% of Levee System	%	
Upper Rincon	0.0	0.0	0.0	0.0	0.0	0
Lower Rincon	10.5	34.5	9.0	29.6	4.93	1.18
Upper Mesilla	5.7	71.3	5.4	67.5	3.75	0.9
Las Cruces	18.7	91.2	18.2	88.8	2.44	0.59
Lower Mesilla	10.5	27.6	10.2	26.8	0.79	0.19
El Paso	17.3	70.0	17.3	70.0	0.0	0
Total	62.7	48.1	60.1	45.9	2.29	0.55

* Average increase in levee height above a 2 ft rehabilitation average assumed for current floodway conditions

A low potential for levee deficiency increase as a result of project implementation was identified under current conditions (without flood control improvements). No linear projects and only four locations where identified as having an adverse effect on flood control under current conditions. Those locations correspond to point projects at river miles 42, 48, 76 and 83 (either planting sites and/or stream bank shavedowns) that are

under consideration for the Integrated USIBWC Land Management Alternative (Table 4.2-3). Reductions in feeboard below the 3-feet design value as a result of increased vegetation, as simulated by hydraulic modeling, are tabulated in Appendix E, Table E-2.

Table 4.2-3 Point Projects with a Potential to Reduce Freeboard Below Design Values

River Mile ID	Site Name	Measure A: Native Vegetation Planting	Measure B: Stream Bank Shavedowns	Measure C: Open Former Meanders	Measure D: Modify Dredging at Arroyos
105	Oxbow Restoration	105A		105C	
104	Tipton Arroyo	104A	104B		104D
103	Trujillo Arroyo		103B		103D
102	Montoya Arroyo	102A	102B	102C	102D
101	Holguin Arroyo	101A	101B		101D
99	Green/Tierra Blanca Arroyos	99A			99D
98	Sibley Point Bar		98B		98D
97	Jaralosa Arroyo			97C	97D
95	Jaralosa South	95A		95C	
94	Yeso Arroyo	94A	94B		94D
92	Crow Canyon		92B	92C	
85	Placitas Arroyo				85D
83	Remnant Bosque	**83A***	**83B***		83D
78	Rincon/Reed Arroyos				**83B***
76	Bignell Arroyo	**76A***	**76B***		76D
54	Channel Cut	54A		54C	
49	Spillway No. 39	**49A***			
48	Spillway No. 8	**48A***			
42	Clark Lateral	42A			
41	Picacho and NMGF	41A			

* Highlighted locations indicate that, under current conditions, environmental measure implementation would result in a levee freeboard less that 3 feet, or an increase in already existing freeboard deficiencies.

4.2.6 Targeted River Restoration Alternative

Potential effects of the levee rehabilitation program under this alternative would be similar to those described for the Integrated USIBWC Land Management. The extent of riparian vegetation growth and floodway management within the levee system would be similar for the two alternatives.

For the Targeted River Restoration Alternative, five locations were identified where point project implementation under current conditions (without flood control improvements) would have an adverse effect on flood control. Those projects are located at river miles 42, 48, 76, 78 and 83 (Table 4.2-3). Reductions in levee feeboard below the 3-feet design value as a result of increased vegetation, as simulated by hydraulic modeling, are tabulated in Appendix E, Table E-2. No linear projects, with exception of those associated with seasonal peak flows, would have an adverse effect on flood control. Developing native bosques through the use of seasonal peak flows would have an adverse effect on flood control at some sites south of river mile 83 to Leasburg Diversion Dam.

4.3 SOILS

Effects to soils are a function of direct short-term effects of construction and environmental measure implementation (*i.e.* earthwork, scouring from pulse flows, selective clearing) and long-term effects such as soil erosion in response to grazing. Effects of alternatives to soils were based on the following evaluation criteria:

- Amount of soil displaced or eroded from construction of levees and implementation of environmental measures;
- Amount of soil erosion as a result of grazing practices; and
- Environmental construction for excavation of arroyo, meanders, and earthwork.

4.3.1 Method of Analysis

General Assumptions

A GIS was used to calculate extent and location of measures. The results of the GIS analyses were assessed against baseline values. Assumptions and calculation used for assessing effects to soils through implementation of environmental measures are listed in Tables 4.3-1 – 4.3-5.

Construction Estimates for Levee System Rehabilitation

All action alternatives include levee construction measures that increase levee height and add additional levees or floodwalls. The assumption adopted in the DEIS to quantify construction activities for potential effects is that existing levees would be raised to meet freeboard design criteria or new levees would be constructed in unconfined areas where flood levels would extend past the ROW boundary.

In areas where rebuilding of levees would be required, existing levee material would be re-engineered with clay material to meet specifications for the new levee. Additional material would be obtained from sediment removed during implementation of environmental measures or from new borrow sites. Increase in levee footprint was used as evaluation criteria.

Soil Excavation Estimate for Environmental Measures

The Integrated USIBWC Land Management Alternative and Targeted River Restoration Alternative include excavating soil as part of implementing environmental measures (Tables 4.3-3 and 4.3-4). All soil excavated would be placed on existing levees or floodway and revegetated as part of the modified grassland measure. Soil salinity management could be required to facilitate revegetation of desired species.

Table 4.3-1 Basis for Soil Calculations

Measure	Loss (ac-ft)	Description
Levee rehabilitation	898	Levee volume estimates (additional material would be hauled from borrow areas outside of ROW; increase in levee footprint.
Modified grassland management in uplands	--	Erosion reduced by >50% in uplands by increasing cover to an average of 40%. The sediment yield analyses equation used was the Modified Universal Soil Loss Equation (MUSLE) (USACE 1996).
Modified grassland management in riparian areas	--	Shallow (<8") soil disturbance during site preparation and native grass planting. Minor soil erosion was assumed as a result of incorporating BMPs during construction and as vegetation reestablishes. Herbicidal treatments would be used to kill woody vegetation in previously mowed areas. Additional soil treatments to manage salinity could be required. Minor soil erosion was assumed during implementation of vegetation maintenance activities such as salt cedar control and fuel reduction.
Plant woody native vegetation	--	Herbicidal treatments would be used to kill woody vegetation in previously mowed areas. In woodland areas selected for planting, implementation could include mechanical clearing, herbicide application, salinity management, and hauling of material. Maintenance using mechanical salt cedar removal methods would avoid the river edge and wetlands locations. Minor soil erosion was assumed for vegetation maintenance activities such as salt cedar control and fuel reduction.
Enhance existing bosques	--	Minor soil erosion during selective removal and hauling of material. Mechanical salt cedar removal methods would avoid the river edge and wetlands locations and cleared using manual methods. Minor soil erosion was assumed as a result of incorporating BMPs during construction and as vegetation reestablishes.
Bank shavedowns	157	Assumed excavation of 127 acres to within 1 foot of mean irrigation flow. Table 4.3-3 list calculations. Soil would be placed in the floodway. Loss of soil during construction (incidental fill) and due to overbank flows would be minimal through incorporating BMPs and overflow bank design that promotes backflow inundation. Maintenance using mechanical salt cedar removal methods would avoid the river edge and wetlands locations. Minor soil erosion was assumed during maintenance activities such as salt cedar control and fuel reduction.
Opening former meanders	225	Excavation calculations assumed ½ volume of meander excavation depth (3 ft. below irrigation level). Material would be deposited in floodway. Loss of soil due to opening menders (incidental fill) would be minimal. Minor soil erosion was assumed during implementation of vegetation maintenance activities such as salt cedar control and fuel reduction. Site 105 and 92 listed with additional assumptions: Site 105.– assumed above excavation calculation but for only ½ of meander length. Site is currently riparian woodland. Site 92 assumed above excavation calculation but for only 1/4 of meander length. Site is very high relative irrigation water level and outside hydrologic floodplain.
Modify dredging at arroyos	27.3	6.82 acres excavated an average of 4 feet. Material would be deposited in floodway.
Seasonal peak flows /bank preparation	43	Preparation and clearing of 517 acres. Shallow (<8") soil disturbance during site preparation. Assumes minor soil erosion as vegetation reestablishes. Loss of soil during overbank flows estimated at 1 inch per acre for 517 acres, or 43 ac-ft. Maintenance using mechanical salt cedar removal methods would avoid the river edge and wetlands locations. Minor soil erosion was assumed during maintenance activities such as salt cedar control and fuel reduction.
Conservation easements	n/a	Selective removal and clearing by mechanical or manual means. Shallow (<8") soil disturbance during site preparation and native grass planting for 288 ac. Minor soil erosion was assumed as a result of incorporating BMPs during construction and as vegetation reestablishes. Minor soil erosion was assumed during maintenance activities such as salt cedar control and fuel reduction. Maintenance using mechanical salt cedar removal methods would avoid the river edge and wetlands locations.

Table 4.3-2 Construction Estimates for Levee System Rehabilitation

		BY RIVER MANAGEMENT UNIT						
	Entire RGCP	**Upper Rincon**	**Lower Rincon**	**Seldon Canyon**	**Upper Mesilla**	**Las Cruces**	**Lower Mesilla**	**El Paso**
River Mile:	**105 - 0**	**105 - 90**	**90 - 72**	**72 - 63**	**63 - 51**	**51 - 40**	**40 - 21**	**21 - 0**
Levee volume (ac-ft.)	898.1	0	127.7	0	67.6	230.6	128.3	344
Levee footprint increase (acres)	114.3	0.0	15.4	0.0	7.1	24.1	13.5	54.2
Riprap volume (1,000 c.y.)	35.5	2.2	11.0	0	0.0	0.0	10.0	12.3
Borrow site size (acres) (assumes 6 ft excavation depth)	149	0	21	0	11	38	22	57

Table 4.3-3 Soil Excavation Estimates for Conducting Bank Shavedowns

Point Projects	Shavedowns for Riparian Vegetation (acres)	Reference Irrigation Flow Elevation (feet)	Average Bank Elevation (feet)	Excavation Volume* (acre-ft)
104B - Total	3.4	4128.8	4131.0	3.92
103B	*3.8*	*4127.7*	*4131.0*	*8.69*
103B	*4.3*	*4127.0*	*4128.5*	*2.12*
103B	*14.0*	*4123.8*	*4126.5*	*23.8*
103B	*2.0*	*4123.5*	*4128.0*	*6.93*
103B	*2.5*	*4123.1*	*4125.5*	*3.51*
103B - Total	26.6	--	--	45.1
102B	11.1	4122.8	4125.0	13.3
102B	1.9	4122.6	4125.0	2.70
102B	11.7	4118.7	4120.0	3.51
102B - Total	24.7	--	--	19.5
101B	*9.7*	*4117.9*	*4120.5*	*15.5*
101B	*2.9*	*4117.4*	*4120.0*	*4.62*
101B -Total	12.6	--	--	20.1
98B Total	4.1	4109.0	4112.0	8.24
94B Total	3.9	4089.0	4092.0	7.78
92B Total	17.9	4074.0	4077.0	35.7
83B Total	17.9	4043.3	4044.5	3.57
76B Total	16.3	4012.2	4014.0	13.0
Total	127	--	--	**157**

* See Table 4.3-1 for assumptions concerning volume estimates

Table 4.3-4 Soil Excavation Estimates for Opening Meanders

Mile ID	Measure ID	Former Meander	Average Irrigation Flow Elevation	Average Bank Elevation	Average Height Above Irrigation Flow	Volume of Sediment ac-ft
105	105c	6.6	4129.9	4133	3.1	10.1
102	102c	2.8	4121	4125	4.0	9.8
97*	97c	28.0	4100.9	4106	5.1	56.7
95	95c	5.1	4090.8	4093.5	2.7	14.5
92*	92c	84.6	4077	4082	5.0	84.6
54	54c	19.6	3924	3926	2.0	49.0
Total						**225**

*Sites are outside the hydrologic floodplain but selected due to other criteria.

4.3.2 Summary of Potential Effects

Table 4.3-5 presents a summary of alternative effects on soils. Levee construction accounts for the majority of soil effects.

Table 4.3-5 Soils Summary of Potential Effects

Evaluation Criteria	No Action		Flood Control Improvement		Integrated USIBWC Land Management		Targeted River Restoration	
	Acre-feet	% of baseline	Acre-feet	% of baseline	Acre-feet	% of baseline	Acre-feet	% of baseline
Erosion from uplands (*Percent values represent a decrease in erosion due to measure)*	0.71	No change	0.45	64%	0.45	64%	0.45	64%
Construction of levees	0	No change	898		898		898	
Environmental project construction	0	No change	0	No change	157		295	

4.3.3 No Action Alternative

Under the No Action alternative, soil erosion in the uplands and floodway is not expected to change from baseline conditions. Vegetative cover is currently estimated at <20 percent for upland vegetation and would likely remain consistent with baseline conditions under the current grazing regime.

4.3.4 Flood Control Improvement Alternative

Under this alternative, 898.1 ac-ft of material would be used for levee construction increasing levee footprint by 114.3 acres (Table 4.3-2). Based on engineering requirements, the soil within the levee footprint could be excavated and replaced by more structurally suitable material or buried and contained within the levee. Modified grazing in 1,805 acres of uplands would reduce sedimentation into the RGCP by 0.45 ac-ft annually (Table 4.3-6). Modified grazing in the riparian areas would likely improve bank stability and reduce potential soil loss due to increased vegetative cover. Table 4.3-6

provides a summary of soil effects of the Flood Control Improvement Alternative by RMU.

Table 4.3-6 Soil Effects of the Flood Control Improvement Alternative

Evaluation Criteria	River Management Unit (acre-feet)							
	Upper Rincon	Lower Rincon	Seldon Canyon	Upper Mesilla	Las Cruces	Lower Mesilla	El Paso	Total
Erosion from upland	0.29	0.16	nc	nc	nc	nc	nc	0.45
Construction of levees	nc	127.7	nc	67.6	230.6	128.3	344	898.1
Environmental project construction	nc	nc	nc	nc	nc	nc	nc	nc

nc= no change

Soil Erosion

Increasing upland vegetative cover to 40 percent would decrease sediment to 0.45 ac-ft annually (Table 4.3-6). It is anticipated vegetation response to modified grazing management would take several years. Beneficial effects for the floodway would include reduced bank erosion and sediment entering the river. It is anticipated that grazing in riparian areas would be reduced or temporally ceased to allow vegetation to recover and fencing constructed to exclude cattle from the river banks and wetlands areas.

Construction of Levees and Environmental Projects

A total of 114 acres of floodway would be affected due to levee rehabilitation (Table 4.3-2). Soils within the levee footprint could be excavated, but would likely be covered with overburden.

Vegetation maintenance activates for grazing leases could include treatments such as re-seeding and woody vegetation control (mechanical and chemical treatments) in order to increase vegetation cover. Maintenance of floodway vegetation within grazing leases would include invasive species control to contain the extent of salt cedar. It is estimated that 30 percent of current grazing areas are riparian woodland dominated by salt cedar. Invasive species treatments would replace or compliment current mowing practice and could include chemical (such as Garlan4®) applications, mechanical treatments and prescribed burns. Details of treatments would be based on site-specific conditions.

Chemicals such as Garlan4® would have no direct effect on soils given the expected short half-life of the compounds in soils. Due to the herbicide's low toxicity level and relatively short half-life periods (about 100 days for some compounds; most compounds less than 30 days) there would not be a long-term affect to using this product (USEPA 1998). The chemical application would be done in a way to avoid spills and be directed specifically at target areas. The chemical treatment would be applied during dry weather conditions when winds are minimal to prevent broadcast distribution over a larger area.

Use of mechanical equipment can cause soil alterations, compaction and rutting in heavily traveled areas. Alteration of natural drainage patterns within the micro-

topography caused by mechanical equipment may locally alter soil topography within the savanna community. Mechanized vehicles would avoid impacting areas larger than necessary. The vehicles would be used in dry weather conditions to avoid soil rutting and compaction that would occur during wet conditions.

Prescribed burns may have various short-term effects on soil conditions. Soil organic matter is often increased by light burns, but can be decreased by intense fires. Nitrogen is often volatilized when vegetation and forest litter are burned. Nitrogen that is not lost by burning often becomes more available to plants, and soil nitrogen increases very much like the increase in organic matter (Agee 1974).

4.3.5 Integrated USIBWC Land Management Alternative

Under this alternative, soil effects due to levee rehabilitation and modified grazing would be the same as the Flood Control Improvement Alternative. Bank shavedowns would result in the removal of 157 ac-ft of fluvial soils (see Table 4.3-3 for calculations). Shavedown material would be deposited on existing levee toe and slopes and re-vegetated. Table 4.3-7 provides a summary of potential effects of the Integrated USIBWC Land Management Alternative by RMU and the reduced erosion volume.

Table 4.3-7 Soil Effects of the Integrated USIBWC Land Management Alternative

Evaluation Criteria	River Management Unit (acre-feet)							
	Upper Rincon	Lower Rincon	Seldon Canyon	Upper Mesilla	Las Cruces	Lower Mesilla	El Paso	Total
Erosion from uplands	0.29	0.16	nc	nc	nc	nc	nc	0.45
Construction of levees	nc	127.7	nc	67.6	230.6	128.3	344	898.1
Environmental project construction [bank shavedowns]	140	17	nc	nc	nc	nc	nc	157

nc= no change

Soil Erosion

Same as Flood Control Improvement Alternative.

Construction of Levees and Environmental Project Construction

Levee rehabilitation effects are the same as Flood Control Improvement Alternative. Maintenance of grazing leases and levees is the same as Flood Control Improvement Alternative.

Bank shavedowns would displace 157 ac-ft (Table 4.3-3) of fluvial soil in the Rincon valley. Loss of soil due to overbank flows would be minimal through incorporating Best Management Practices (BMPs) and overflow bank design that promotes backflow inundation. Soils placed in floodway would be revegetated as part of the modified grassland measure. The modified grassland measure would replace 1,641 acres of mowing with native grasslands (see Table 2.6-2). The measure would

result in minor short-term shallow soil disturbance during site preparation. Effects of invasive species control from chemical, fire and mechanical treatments are similar to the Flood Control Improvement Alternative.

4.3.6 Targeted River Restoration

Under this alternative, soil effects due to levee rehabilitation construction and modified grazing would be the same as the Flood Control Improvement Alternative and Integrated USIBWC Land Management Alternative. A total of 252 ac-ft of soil would be displaced due to project construction and 43 ac-ft lost to erosion during overbank flows. Table 4.3-8 provides a summary of potential effects of the Targeted River Restoration Alternative.

Table 4.3-8 Soil Effects of the Targeted River Restoration Alternative

Evaluation Criteria	River Management Unit (acre-feet)							
	Upper Rincon	Lower Rincon	Seldon Canyon	Upper Mesilla	Las Cruces	Lower Mesilla	El Paso	Total
Erosion from uplands	0.29	0.16	nc	nc	nc	nc	nc	0.45
Construction of levees	nc	27.7	nc	67.6	230.6	128.3	344	898.1
Environmental project construction [*opening meanders and modify dredging at arroyos*]	186	17	nc	49	nc	nc	nc	252
Loss of soil due to scarring [*Seasonal peak flows /bank preparation*]	17.8	25	nc	nc	nc	nc	nc	43

nc= no change

Soil Erosion

Same as Flood Control Improvement Alternative and Integrated USIBWC Land Management Alternative.

Construction of Levees and Environmental Measure Implementation

Levee rehabilitation effects are the same as Flood Control Improvement Alternative and Integrated USIBWC Land Management Alternative. Opening former meanders would result in the removal of 225 ac-ft of fluvial soils (much of if recent overburden fill created during project construction and maintenance). Table 4.3-4 shows totals by meander. Material would be deposited in the floodway or on the toe and slope of the levee. Loss of soil (incidental fill) due to opening menders would be minimal for 6 meanders. Excavation of arroyos would result in the removal of 27.3 acres (Table 4.3-1). Combined meanders and arroyo excavation would equal 252 acres.

Bank preparation for 517 acres of overbank flows would result in the removal of vegetation and shallow soil disturbance in preparation of overbank flows. Direct effects of seasonal peak flows includes erosion of prepared banks and potential bank incisions. Loss of soil due to overbank flows is estimated at 1-inch per acre for 517 acres (43 ac-ft).

The majority of excavation from opening meanders would occur in the Upper Rincon Valley RMU. Excavation associated with aquatic habitat diversification would occur in the Upper and Lower Valley RMUs. Replacement of 1,641 acres of mowing with native grasslands would result in minor short-term shallow soil disturbance during site preparation. Measures conducted in conservation easements would also result in minor soil disturbance assuming BMPs are implemented.

Long-term maintenance of grazing leases and levees is the same as the Flood Control Improvement Alternative. Maintenance of areas inundated by seasonal flows could include re-seeding, planting, and woody vegetation control. Details of treatments would be based on site-specific conditions. Soil disturbance would be minimized through incorporation of BMPs. Effects of invasive species control from chemical, fire and mechanical treatments are similar to the Flood Control Improvement Alternative.

4.4 VEGETATION AND WETLANDS

Effects on vegetation and wetlands are a function of direct short-term effects of construction and environmental measure implementation (*i.e.* earthwork, scouring from pulse flows, selective clearing) but more significantly the long-term effects of modifying vegetation management practices and restoring or improving vegetation communities (reference communities). The following evaluation criteria were used for the analyses:

Changes in the Extent of Vegetation

- Amount of uplands; and
- Amount riparian vegetation (including wetlands).

Changes in Community Composition

- Amount of reference community created.

Changes in Vegetation Management

- Amount of salt cedar woodland removed;
- Amount of annual mowing by USIBWC;
- Amount of annual grazing leases ; and
- Amount of crop leases.

4.4.1 Method of Analysis

Extent of Vegetation

Changes in upland and riparian vegetation were compared to baseline values (Table 3.4-4). A GIS was used to calculate the construction footprint associated with environmental measures to assess changes in vegetation.

Community Composition

Changes in community composition were assessed by calculating the amount of reference community developed as a result of implementing environmental measures. Assumptions concerning changes in community composition include:

- The current anthropomorphic factors would continue to be the dominating influence. Specifically the highly altered hydrologic and sediment regime would remain in place through the analysis period.
- The amount of reference community created assumed successful implementation of environmental measures.
- Habitat improvements would result in a community comparable to the reference communities identified in Section 2. Sites would vary in seral stage, structure and site-specific characteristics, but generally classified as the reference community.
- Native communities would develop over a 20 year implementation period.

Reference Communities represent the desired future condition of vegetation communities (Table 4.4-1). The actual process of developing desired future communities is dependent on site-specific characteristic and monitoring to achieve success. Implementation of environmental measures would addresses the following questions USACE (2003):

- What is the best combination of vegetation structures, patch sizes and corridors to create a dynamic mosaic?
- What is the most cost-effective combination of various revegetation strategies to achieve the optimum and sustainable mosaic?
- What are the best strategies to remove debris and vegetation?
- What shall be the timing of removal and re-vegetation to be least likely to disrupt wildlife?

Table 4.4-1 lists four reference communities created as a result of implementing environmental measures. The following section describes each of those communities.

Table 4.4-1 Reference Communities Associated with Environmental Measures

Measure	Habitat Type	Reference Community
Modified grazing leases (uplands)	Uplands	Improved uplands
Modified grazing leases (riparian zone)	Riparian	Improved riparian
Modified grassland management	Riparian	Native grasslands
Native vegetation planting	Riparian	Native bosque
Existing bosque enhancement	Riparian	Native bosque
Bank shavedowns	Riparian	Native bosque
Seasonal peak flows/bank preparation	Riparian	Native bosque
Reopening former meanders within ROW	Riparian	Native bosque
Conservation easements	Riparian and uplands	Native bosque, native grasslands and/or remnant bosques

Improved Riparian Community. This community would be developed through modification of floodway grazing lease practices in conjunction with additional salt cedar control methods. Although the primary objective is improved erosion control and bank stability in grazed areas, the improved riparian community would incorporate livestock grazing in a manner more compatible with biological quality and increased forage production. It would develop habitat corridors between patches of bosque, provide increased protection of floodway wetlands, contain the expansion of existing large stands of non-native vegetation, and enhance wildlife habitat. Grazing would be managed to promote regeneration of native vegetation and increase species diversity. Grazing management could include vegetation treatments such as burning, mechanically clearing and re-seeding. Improving and installing fences and water sources would be the responsibility of leaseholder.

Despite the improved habitat quality, the reference community would continue to be disconnected from the river, composed primarily of herbaceous vegetation with woodlands dominated by invasive species. However, the herbaceous vegetation would be structurally and floristically diverse. Salt cedar would be controlled to limit additional expansion. Vegetation along the river and in wetlands locations would be maintained in a manner that improves bank stability and decreases potential sedimentation.

Improved Uplands Community. This community would be developed through modification of upland grazing lease practices more compatible with increasing vegetative cover to reduce soil erosion and enhance wildlife habitat. The reference community would be dominated by upland herbaceous vegetation with a percent cover equal to or greater than 40 percent. Leases would be managed to increase the amount of palatable grass species such as grama grass species and other bunch grasses. Modified grazing regimes in conjunction with woody vegetation management would result in a greater contribution of less grazing tolerant grass species, more ground cover and improved soil stabilization.

Native Grassland Communities. Grasses have the greatest potential for holding soils, thus decreasing erosion. They also can create open areas, which coupled with densely wooded patches create an edge habitat that is ideally suited for many wildlife species (USACE 2003). Native grasslands would be developed to improve habitat corridors between patches of bosque, provide increased protection of riparian wetlands, and enhance wildlife habitat. This reference community would continue to be disconnected from the river, and be composed primarily of intermediate and xeric native grasses and other herbaceous vegetation. Within isolated mesic and hydric areas, species would include salt grass, cattail, sedges, and rushes.

Grasslands would be established by plantings and maintained through woody vegetation control. A woody component would likely be present, but typically less then a 20 percent aerial coverage. Where appropriate, woody vegetation would be retained for structural diversity and would include native woody vegetation such as screw bean mesquite. More xeric species would become established on higher sites. Salt cedar would be controlled. Vegetation along the river and in wetlands locations would not be maintained, with the exception of salt cedar removal to improve bank stability and decrease potential erosion and sedimentation.

Prescribed burning of grassland may be warranted to improve grass production. Most grasses are relatively tolerant of fire, and the subsequent nutrient pulse would allow grasses to rapidly recover after a fire. If native grasses are well-established, burning would control most woody plants (if they are small) and would promote growth of most herbaceous plants. In addition, if native plants are well established, particularly in the rooting zone, burning would not harm the roots and the soil would remain stabilized (Scurlock 1998; Crawford *et al*., 1996).

Native Bosque Community. Developing and sustaining native bosque communities could include clearing, hydrologic modifications, planting/natural regeneration, salt cedar control, fuel reduction, and natural or induced flooding (USACE 2003). This reference community would be floristically and structurally similar to native riparian communities characterized by uneven aged, multi strata woody plants, with interspersed grasslands and isolated wetlands. The community would be considered connected, with the potential for overbank flows and long-term sustainability. Invasive vegetation, particularly salt cedar, would compose less than 50 percent of the community. Dominant woody species would include cottonwood and willow, with other species occurring such as western chokeberry, New Mexico olive, false indigo bush, and wolfberry among others.

Development of this community would require considerable site preparation, salt cedar control, and in some areas removal of Russian olive. Periodic reduction in fuel loads may be required. Fuel load reduction consists of removing dead and fallen trees and excess leaf litter. When the flood disturbance regime was still functional, much of this material would have been removed by periodic flooding (USACE 2003).

Vegetation Management

Changes in vegetation management were compared to baseline values. Vegetation management primarily includes activities associated with salt cedar control, but also includes crop leases and no-mow zones. It does not include changes to recreational and park leases. Salt cedar reduction estimates were calculated by comparing the construction footprint against vegetation classification maps. Assumptions concerning vegetation management included:

- Woodland communities, croplands and no-mow zones are currently not mowed either by USIBWC or grazing lease holders. All other vegetation communities are mowed by USIBWC or by lease holders.
- Implementing some environmental measures could result in a net decrease in the acreage of invasive species. However, in most cases, no net decrease of invasive species was assumed because mowing of the ROW currently manages salt cedar and the majority of the ROW is mowed.

Table 4.4-2 list assumptions regarding calculations used in assessing changes in vegetation management.

Table 4.4-2 Assumptions Used to Assess Effects Associated with Vegetation Management

Measures	Vegetation Management	Salt Cedar Removal and Maintenance
Levee rehabilitation	Assumed that grazing lease boundaries would be modified to compensate for implementing measure when possible.	Levees would continue to be mowed. No additional salt cedar would be eliminated above the amount removed under current mowing management.
Modified grazing in uplands	All uplands vegetation in the Rincon Valley was classified as part of grazed lands (1,805 ac).	Assumed no salt cedar would be removed in addition to the amount currently controlled. Management would shift to improved erosion control.
Modified grassland management in floodway	A total of 1,747 acres were classified as riparian. In some cases, riparian leases would be eliminated and converted to native grasslands.	Invasive species maintenance would likely include conducting prescribed burns, soil salinity management, applying herbicide and potentially rotational mowing. Management would emphasize the development of improved wildlife habitat.
Plant woody native vegetation	Assumed conversion of mowed areas to native bosque. In some cases, riparian lease acres would be reduced. 223 acres and 189 acres would be planted under the Integrated USIBWC Land Management and Targeted River Restoration alternatives, respectively.	Assumed all invasive vegetation within planting areas would be removed and soil salinity management instituted during site preparation. Salt cedar removal estimated at 77 acres and 65 acres for the Integrated USIBWC Land Management and Targeted River Restoration alternatives, respectively. Long-term invasive species maintenance would include selective removal of invasive species and fuel reduction.
Enhance existing bosques	Bosque enhancement would be conducted in areas currently classed as riparian woodland within the hydrologic floodplain. Totals are included in the "plant woody vegetation measure."	Assumed >50% of established woodland in hydrologic floodplain would be removed during site preparation. Long-term maintenance would include selective removal of invasive species and fuel reduction to reduce chance of uncontrolled fire.
Bank shavedowns	A total of 127 acres of floodway would be shavedown. Conversion to native bosque from mowed areas. A total of 157 ac-ft of sediment from bank shavedowns would be distributed on floodway an average of 2 foot deep, or 77 surface ac. Shavedowns would be conducted in conjunction with native grassland seeding. 10% of shavedown areas are assumed to become future wetlands	Assumed all woodlands within shavedown areas would be removed during site preparation. Salt cedar removal estimated at 53 ac. Long-term maintenance would include selective removal of invasive species and fuel reduction to uncontrolled fire potential.
Opening former meanders	A total of 147 acres of former meanders would be affected. Assumed total excavated lands converted at a proportion 50% native bosque, 20% wetlands and 30% backwater (pool) habitat. A total of 224 ac-ft of sediment from bank shavedowns would be distributed on levees and floodway an average of 2 foot deep or over 112 surface acres. Native grass seeding would be conducted on displaced soil.	Assumed all woodlands within construction footprint would be removed during site preparation. Salt cedar removal estimated at 88 ac. Long-term maintenance would include selective removal of invasive species and fuel reduction to reduce uncontrolled fire potential.
Modify dredging at arroyos	A total of 27 ac-ft of sediment from arroyo dredging would be distributed on floodway an average of 2 foot deep or 14 surface acres. Native grass seeding would be conducted on displaced soil.	None
Seasonal peak flows / bank preparation	Conversion of 517 ac to native bosque from grazing leases and mowed areas. If possible, lease boundaries would be modified to compensate for implementing measure.	Assumed all woodlands within overbank flows would be removed during site preparation. Salt cedar removal estimated at 217 ac. Long-term maintenance would include selective removal of invasive species and fuel reduction to reduce uncontrolled fire potential.
Conservation easements	Assumed lands in hydrologic floodplain (771 ac) used primarily for riparian restoration (some lands <10% classed as wetlands), all croplands (288 ac) converted to native grasslands and remaining conservation easement (559 ac) preserved at current levels.	Assumed 20-25% of established woodland in hydrologic floodplain would be removed during site preparation (salt cedar removal estimated at 173 ac). Maintenance would include selective removal of invasive species and fuel reduction to reduce chance of uncontrolled fire. No salt cedar control would be conducted outside hydrologic floodplain.

4.4.2 Summary of Potential Effects

Table 4.4-3 presents a summary of effects for vegetation and wetland. The extent of upland community is unchanged from baseline irrespective of alternative. The amount of riparian community increases only in the Targeted River Restoration Alternative. Restoration measures under the Integrated Lands Management and Targeted River Restoration alternatives result in increased amounts of wetlands and native communities. Each of the action alternatives includes modification of uplands and riparian grazing regimes and levee rehabilitation.

Table 4.4-3 Summary of Effects for Vegetation and Wetland

Evaluation Criteria	No Action		Flood Control Improvement		Integrated USIBWC Land Management		Targeted River Restoration	
	Acres	Change	Acres	Change	Acres	Change	Acres	Change
Extent of Vegetation								
Total lands	8,332	nc	8,332	nc	8,332	nc	9,933	19%
Uplands vegetation	1,805	nc	1,805	nc	1,805	nc	1,805	nc
Riparian vegetation - total	6,527	nc	6,527	nc	6,527	nc	8,103	24%
Riparian vegetation - wetlands	177	nc	177	nc	190	7%	283	60%
Community Composition								
Improved uplands	nc	nc	1,805		1,805		1,805	
Improved riparian	nc	nc	1,747		1,747		1,688	
Native bosque or cottonwood/ willow riparian community	nc	nc	nc	nc	350		1,549	
Native grasslands	nc	nc	nc	nc	1,641		1,929	
Salt cedar reduction by initial implementation of environmental measures	nc	nc	nc	nc	130		543	
Vegetation Management								
Modified upland grazing leases	nc	nc	1,805	100%	1,805	100%	1,805	(-100%)
Vegetation control in the floodway by grazing leases	1,747	nc	0	(-100%)	0	(-100%)	0	(-100%)
Crop leases	66	nc	66	nc	66	nc	66	nc
Annual mowing	4,657	nc	4,657	nc	2,674	-43%	2,223	-52%
No-mow zones	57	1.2%	57	1.2%	57	2.1%	57	2.5%

nc=no change

4.4.3 No Action Alternative

Under the No Action alternative, vegetation communities would remain consistent with baseline conditions.

Extent of Vegetation

No change in the amount of the upland and riparian vegetation would occur.

Vegetation Composition

Management practices would likely keep the vegetation composition consistent with the baseline condition; however, increases in invasive species could occur in lease areas. An estimated 30 percent of leased areas contain invasive dominated woodland communities. Areas inaccessible to mowers would continue to be dominated by salt cedar. Vegetation reduction through mowing would be a direct and short-term effect. Long-term term effects would be minor as vegetation would re-grow after treatment.

Salt cedar would continue to dominate with the exception of isolated pockets of native vegetation. Mowing would suppress salt cedar for almost 5,000 acres (USIBWC mowing and lease holder agreements); however, salt cedar root crowns regrow vigorously after mowing and can reach a height of 9 feet or more in one season. Existing stands of salt cedar which are not mowed would continue to thrive.

The long-term effects of the No Action Alternative would likely result in the decrease in the number of isolated pockets of cottonwoods. Colonization by native species can be inhibited by the prevalence of salt cedar. Very limited opportunities exist for establishment of native vegetation. The floodway would continue to remain largely disassociated from the river providing little scouring potential. Occasional periodic overbank flows would not likely be sufficient to create suitable cottonwood regeneration conditions. Decline of scattered mature cottonwoods would continue and natural regeneration would be limited to isolated pockets such as Sunland Park in El Paso. Avoidance of these pockets by mowers would continue, however, the lack of salt cedar removal actions would likely result in encroachment by salt cedar.

Vegetation Management

There would be no changes in vegetation management relative to current conditions. Mowing will continue to control salt cedar as indicated in Table 4.4-4. A total of 1,805 acres of uplands are leased in the Rincon Valley. Woody shrubland vegetation within the floodway would be cut back annually. Crop leases would continue for 66 acres in the Rincon Valley.

Table 4.4-4 Invasive Species Management in the Floodway Under the No Action Alternative

Method	Acreage	Comments
Grazing leases (mowing by lease holders)	1,747	Grazing leases require that brush and vegetation be removed or mowed annually within portions of the lease.
Mowing by USIBWC	4,657	Farm tractors with rotary slope mowers are generally used to mow the floodways. Slope mowers are used for vegetation maintenance on the channel banks. Some areas with dense vegetation may require a second late summer mowing.

Grazing in the riparian community would continue for 1,747 acres resulting in reduced vegetative cover. The few mature native cottonwoods would decline and not likely be replaced due to lack of favorable recruitment conditions. Mowing would continue to maintain the majority of the floodplain in an early seral state.

4.4.4 Flood Control Improvement Alternative

Under this alternative, vegetation would be directly impacted through a modification of grazing leases and the rehabilitation of levees. Decline of scattered mature cottonwoods would continue and natural regeneration would be limited to isolated pockets. Limited opportunities would exist for establishment and maintenance of native vegetation, although modified grazing regimes would potentially result in some recruitment. The floodway would continue to exhibit perched banks and remain largely disassociated from the river.

Extent of Vegetation

No change in the amount of upland, riparian and wetlands vegetation.

Vegetation Composition

As the grazing regime is modified, species composition of the uplands would be subject to change. The uplands vegetation community would likely respond by an increase in species intolerant of grazing pressure. Modified grazing regime in the floodway in conjunction with salt cedar control program would increase the amount of herbaceous vegetation. Salt cedar control could include mechanical, chemical, and burning. Table 4.4-5 provides a summary of the effects expected as a result of implementing this alternative.

Table 4.4-5 Effect Summary of Flood Control Improvement Alternative

Vegetation	Upper Rincon	Lower Rincon	Seldon Canyon	Upper Mesilla	Las Cruces	Lower Mesilla	El Paso	Total
Extent of Vegetation (acres)								
Total lands	nc	nc	nc	nc	nc	nc	nc	nc
Uplands vegetation	nc	nc	nc	nc	nc	nc	nc	nc
Riparian vegetation total	nc	nc	nc	nc	nc	nc	nc	nc
Riparian vegetation- wetlands	nc	nc	nc	nc	nc	nc	nc	nc
Community Composition (acres)								
Improved uplands	1,641	164	nc	nc	nc	nc	nc	1,805
Improved riparian	270	309	nc	638	136	256	138	1,747
Native bosque or cottonwood /willow riparian community	nc	nc	nc	nc	nc	nc	nc	nc
Native grasslands	nc	nc	nc	nc	nc	nc	nc	nc
Vegetation Management (acres)								
Mod. upland grazing leases	1,641	164	nc	nc	nc	nc	nc	1,805
Mod. floodway grazing leases	270	309	nc	638	136	256	138	1,747
Crop lease	nc	nc	nc	nc	nc	nc	nc	nc
Annual mowing (by USIBWC)	nc	nc	nc	nc	nc	nc	nc	nc
No-mow zones	nc	nc	nc	nc	nc	nc	nc	nc

nc=no change

Removal of vegetation would be short-term and associated with O&M activities such as mowing and levee construction. Areas inaccessible to mowers would continue to

be dominated by salt cedar (Table 4.4-5). The 57 acres of no-mow zones (Table 4.4-3)would be maintained and provide management contrast with other floodway vegetation management strategies (grazing and mowing). Vegetation reduction through mowing would be considered a direct and short-term impact. From a long-term perspective, effects to vegetation would be negligible because existing species would re-grow after treatment. Some adverse direct effects to non-target vegetation could occur such as cottonwood and willow trees. Long-term effects to implementing environmental measures would be beneficial due to conversion of treatment areas to reference communities.

The few mature native cottonwoods would continue to decline and not likely be replaced due to lack of favorable recruitment conditions. Cottonwood regeneration through natural seed dispersal would be unlikely within the floodway. With the exception of isolated pockets of native dominated bosque, the riparian woodland would remain a salt cedar dominated community.

Vegetation Management

A total of 1,805 acres of grazing leases would be modified in the Rincon Valley. A grazing regime would be instituted emphasizing the need for improving erosion control though increased vegetative cover. Details concerning the modified grazing program would be developed in concert with regulatory agencies. However, it is assumed that uplands grazing regime would be modified to promote forage production for the purposes of watershed protection. Subsequent vegetative response would result in increased vegetative cover and reduced soil erosion. Based on reference community description, the uplands vegetation would likely exhibit a greater floristic and structural diversity than current baseline conditions. The grazing program could include vegetative treatments such as seeding, prescribed burns and potentially mechanically thinning woody vegetation. The purpose of treatments is to increase species richness, structural diversity and reduce soil erosion. Burning regimes in the upland areas may increase the forage yield of herbaceous species through nutrient addition and site preparation for seedling establishment.

Crop leases would continue for 66 acres in the Rincon Valley. A modified grazing program would be instituted for riparian leases emphasizing forage production for wildlife and watershed management. It is anticipated that some riparian grazing would cease until the vegetation responds at the appropriate level. The modified grazing program would adjust stocking rates based on lease-specific conditions for the purpose of achieving the desired reference community.

The dominate influence of salt cedar would continue throughout the RGCP. Mowing would suppress 4,657 acres (Table 4.4-2) of floodway and modified riparian leases would be used to manage 1,747 acres (Table 4.5-5). The riparian woodland community would remain dominated by salt cedar. Salt cedar control would be implemented to reduce recruitment of invasive vegetation within the riparian zone. Chemical and mechanical treatments would be considered a direct short-term effect. Repeated treatments would be required.

Salt cedar control through herbicide applications of registered herbicide would introduce chemicals in to the environment. Use of spot application techniques would limit chemical exposure to non-target species and individuals. Incidental effects to non-target plant species would be considered a negligible, indirect, adverse effect because typically registered chemicals applied according to label directions and by qualified and trained personnel are relatively non-hazardous.

Prescribed burns would have varying effects, depending on the vegetative community, burn size and intensity, and post-burn conditions. Short-term, minor to moderate, effects would be expected in the treatment areas. Effects include mortality of juveniles and injury to some adult tree and shrub species. Site recovery would depend on each species' resistance or resilience when exposed to disturbance. Long-term, herbaceous communities would benefit from exposure to prescribed fire. Increased soil nutrients concentrations following fire conditions would encourage rapid re-growth of herbaceous vegetation.

The restrictions on the distribution of herbicide applications to spot treatments, use of mechanical equipment designed to minimize damage to soils and non-target plant communities, and restrictions on the degree of clearing to only the treatment areas, would contribute to minimizing adverse effects to non-target vegetation areas.

Table 4.4-6 Invasive Species Management in the Floodway Under the Flood Control Improvement Alternative

Environmental Measure	Acreage	Initial Site Preparation Activities	Long-Term Maintenance
Grazing management in floodway	1,747	Stocking rate evaluation and potential adjustment on a lease by lease basis	Modified - Salt cedar control by chemical or mechanical means (mowing).
Mowing by USIBWC	4,657	No change from current practices	No Change from current practices.

4.4.5 Integrated USIBWC Land Management Alternative

Under this alternative, 3,552 acres of upland (1,805 ac) and riparian (1,747 ac) grazing leases would be modified. Restoration of riparian (350 acres) and herbaceous vegetation (1,641) represent significant changes in floodway management. Mowing would be reduced by 1,983 acres (Table 4.4-7).

Extent of Vegetation

No change to the amount of upland vegetation. Wetland vegetation would increase by 13 acres as a result of shavedowns.

Vegetation Composition

Riparian restoration measures would increase native bosque by 350 acres (127 acres by shavedown and 223 acres by pole planting). With this alternative, the species composition would change from one dominated by salt cedar to include communities of cottonwood and willow. This would require extensive site preparation and invasive plant

removal. Native woody vegetation would increase in the Rincon Valley, Las Cruces and Upper Mesilla RMU.

Table 4.4-7 Effects Summary of Integrated USIBWC Land Management Alternative

Vegetation	Upper Rincon	Lower Rincon	Seldon Canyon	Upper Mesilla	Las Cruces	Lower Mesilla	El Paso	Total
Extent of Vegetation (acres)								
Total lands	nc	nc	nc	nc	nc	nc	nc	nc
Uplands vegetation	nc	nc	nc	nc	nc	nc	nc	nc
Riparian vegetation total	nc	nc	nc	nc	nc	nc	nc	nc
Riparian vegetation-wetlands	9	3	nc	nc	nc	nc	nc	13
Community Composition (acres)								
Improved uplands	1641	164	nc	nc	nc	nc	nc	1805
Improved riparian	270	309	nc	638	136	256	138	1747
Native bosque or cottonwood/ willow riparian community	133	61	nc	20	137	nc	nc	350
Native grasslands	639	611	nc	22	301	68	nc	1641
Vegetation Management (acres)								
Modified upland grazing leases	1,641	164	nc	nc	nc	nc	nc	1,805
Modified floodway grazing leases	270	309	nc	638	136	256	138	1,747
Crop lease	nc	nc	nc	nc	nc	nc	nc	nc
Annual mowing (by USIBWC)	-771	-672	nc	-39	-433	-68	nc	-1,983
No-mow zones	nc	nc	nc	nc	nc	nc	nc	nc

nc=no change

Bank shavedowns would remove 127 acres of existing vegetation in the Rincon Valley. Periodic bank preparation would convert shavedown sites to exposed soil until native vegetation becomes established. Based upon assumptions presented in Table 4.4-2, disposal of shavedown material within the floodway would have a short-term effect on 75 acres of woody vegetation (primarily salt cedar). Pole planting would result in vegetation disturbance within planting sites as a result of site preparation (salt cedar removal, salinity management, *etc*.). Long-term effects due to implementing environmental measures would be beneficial due to the conversion of treatment areas to the reference community.

Vegetation Management

No change would occur from the Flood Control Alternative for upland and floodway grazing. Mowing would be reduced by 1,983 acres. Areas inaccessible to mowers and not targeted for salt cedar removal would continue to be dominated by salt cedar. Crop leases would continue for 66 acres Rincon Valley. The 57 acres of no mow

zones would be maintained and provide management contrast with other riparian vegetation management strategies.

Salt cedar control and fuel reduction would likely be required in all 350 acres of riparian restoration areas to assure native vegetation is sustained. The majority of riparian restoration areas would be dominated by young to mid aged cotton/willow vegetation at the end of the 20-year implementation. Outside the hydrologic floodplain, the floodway would remain disassociated from the river.

Native grasslands would be developed for 1,641 acres of ROW with the majority in the Rincon Valley. The reference community would be characterized as native grassland, however up to 20 percent of the area could be composed of woody vegetation. Salt cedar control would likely be required for much of the 1,641 acres and could include periodic mowing, burning and chemical control in order to sustain native herbaceous vegetation.

Invasive species would be managed by mowing (2,674 acres of floodway), grassland management (1,641 acres) and modified grazing (1,747 acres of floodway). An additional 350 acres of salt cedar control would be required in restored riparian areas. Effects of this alternative on salt cedar would be similar to the Improved Flood Control Alternative. Table 4.4-8 summarizes invasive species management.

Table 4.4-8 Invasive Species Management in the Floodway Under the Integrated USIBWC Land Management Alternative

Measure	Acreage	Initial Site Preparation Activities	Long-term Maintenance
Floodway grazing management	1,747	Stocking rate evaluation and potential adjustments on a lease by lease basis.	Salt cedar control by chemical (spot) or mechanical means. Mechanical removal would be avoided along river edge and wetlands areas.
Native vegetation planting	223	Selective removal and clearing through mechanical means. Mechanical means could be required in dense-monotypic stands.	Salt cedar control by spot application of herbicide or cut-stump methods. Mechanical removal would be avoided along river edge and wetlands areas.
Stream bank reconfiguration	127	Complete removal of vegetation through mechanical means and excavation to within 1 foot of mean irrigation flow.	Salt cedar control by spot application of herbicide or cut-stump methods. Mechanical removal would be avoided along river edge and wetlands areas.
Native grasslands	1,641	Removal of vegetation by herbicide (aerial or spot), shallow disking.	Salt cedar control by chemical (spot). Periodic mowing could be used in some areas. Mechanical removal would be avoided along river edge and wetlands areas.
Mowing	2,674	No change from current practices	No change from current practices.

4.4.6 Targeted River Restoration Alternative

Under this alternative, 3,493 acres of upland (1,805 ac) and floodway (1,688 ac) grazing leases would be managed as improved upland riparian communities. A slight decrease in the amount of riparian grazing leases (currently 1,747 ac) would occur as a result of implementing environmental measures. Through a combination of conservation easements and restoration measures, 1,549 acres of restored riparian habitat and 1,929 acres and native herbaceous vegetation would be developed. With the exception of levees, mowing of the floodway would cease in the Rincon Valley.

Table 4.4-9 Effects Summary of Targeted River Restoration Alternative

Vegetation	Upper Rincon	Lower Rincon	Seldon Canyon	Upper Mesilla	Las Cruces	Lower Mesilla	El Paso	Total
Extent of Vegetation (acres)								
Total lands	-42	536	808	22	nc	202	44	1,576
Uplands vegetation	nc	nc	nc	nc	nc	nc	nc	nc
Riparian vegetation total	-42	536	808	22	nc	202	44	1,576
Riparian vegetation- wetlands	25	21	32	4	17	3	4	106
Community Composition (acres)								
Improved uplands	1641	164	nc	nc	nc	nc	nc	1805
Improved riparian	286	242	nc	635	131	256	138	1,688
Native bosque or cottonwood/ willow riparian community	303	537	351	10	137	168	44	1,549
Native grasslands	639	743	128	50	301	68	nc	1,929
Vegetation Management (acres)								
Modified upland grazing leases	1641	164	nc	nc	nc	nc	nc	1805
Mod. floodway grazing leases	270	309	nc	638	136	256	138	1747
Crop lease	nc	nc	nc	nc	nc	nc	nc	nc
Annual mowing (by USIBWC)	-1,021	-873	nc	-39	-433	-68	nc	-2,434
No-mow zones	nc	nc	nc	nc	nc	nc	nc	nc

nc=no change

Extent of Vegetation

No change would occur to the amount of upland community from the baseline. The total amount of riparian vegetation would increase 1,576 acres from incorporating conservation easements. The majority of increase would occur in Seldon Canyon and the Lower Rincon RMU. Riparian vegetation in the Upper Rincon RMU would slightly decrease by 42 acres as meanders are opened and terrestrial habitat is converted to aquatic habitat (Table 4.4-9). An additional 106 acres of wetlands would be created or managed in this alternative. The primary source of wetland increases would be conservation easements (77 acres) and opening of new meanders (28 acres) within the ROW, (Table 4.4-2 shows assumptions for estimates).

Vegetation Composition

A shift in the floristic composition would occur within the RGCP and adjacent conservation easements. Riparian vegetation in the ROW would be developed through seasonal peak flows planting and opening meanders for a total of 705 acres within the ROW (see section alternative description for ROW average details). Periodic bank preparation would convert overbank flow areas to exposed soil until native vegetation becomes established. This would result in a short-term direct effects to 517 acres of riparian vegetation (Table 4.4-2). Once vegetation becomes established, periodic peak flows would be conducted to sustain native communities (e.g. inundate sites, remove excess vegetation *etc*). Opening meanders would result in a short-term direct impact to 147 acres of riparian vegetation (Table 4.4-2). Long-term effects of environmental measure would be beneficial as current communities would convert to reference

communities. Restoration within conservation easements would add an additional 771 acres of native dominated bosque (Table 4.4-10).

Vegetation Management

No change would occurr within the ROW to grazing and native grassland development from the Integrated Land Management Alternative. However an additional 288 of conservation easements would be developed as native grasslands.

Mowing would be reduced by 2,434 acres (Table 4.4-9). All mowing in the Rincon valley would be restricted to levees. Crop leases would continue for 66 acres of floodway in the Rincon Valley. The 57 acres of no mow zones would be maintained and provide management contrast with other floodway vegetation management strategies.

The incorporation of conservation easements significantly expands the amount of riparian corridor available for restoration. Table 4.4-10 lists conservation easement measures.

Table 4.4-10 Potential Restoration for Conservation Easement

Conservation Easement Location	Acreage	Measure
Cropped easements	288	Native grasslands management
Hydrologic floodplain	771	Native bosque enhancement/planting. The majority of conservation easements located within or adjacent to Seldon Canyon and nearby the Picacho wetlands pilot project.
Other	559	Preservation of corridor width. It includes remnant bosques outside the hydrologic floodplain.
Total	1,618	

Mowing would suppress invasive species in 2,223 acres of floodway, grassland management would control 1,929 acres and a modified floodway grazing program would be used to manage 1,747 acres of floodway. An additional 1,549 acres of salt cedar control would be required in restored riparian areas (Table 4.4-11). Effects of implementing the invasive species program on baseline community are presented as two separate actions, initial site preparation and long-term maintenance.

Salt cedar control would be required in all riparian restoration areas to assure a native dominated component is maintained. The majority of riparian restoration areas would be dominated by young to middle aged cottonwood and willow vegetation at the end of the 20-year implementation. Outside the hydrologic floodplain, the floodway would remain disassociated from the river,

Chemical control of salt cedar would be considered a direct short-term impact. Long-term effects to vegetation would be considered negligible because existing species would re-grow after treatment. Some adverse direct effects to non-target vegetation would occur.

Table 4.4-11 Invasive Species Management in the ROW Under the Targeted River Restoration Alternative

Measure	Acreage	Initial Site Preparation Activities	Long-term Maintenance Activities
Grazing management	1,747	Stocking rate evaluation and potential adjustment on a lease by lease basis.	Salt cedar control by chemical or mechanical means.
Native vegetation planting/enhancement	960	Selective removal and clearing. Mechanical means could be required in dense-monotypic stands. Sites within Seldon Canyon will require extensive removal of mature salt cedar.	Salt cedar control by spot application of herbicide or cut-stump methods. Mechanical removal would be avoided along the river edge and wetlands areas.
Seasonal peak flows /bank preparation	516	Complete removal of vegetation through mechanical means/ bank preparation	Salt cedar control by herbicide or cut-stump methods. Mechanical removal would be avoided along river edge and wetlands.
Native grasslands	1,929	Removal of vegetation by herbicide, shallow disking. Mature woodlands not treated in order to provide structural diversity in floodway.	Salt cedar control by chemical or mechanical means. Periodic mowing could be used in some areas.
Reopening of meanders	142	Complete removal of vegetation through mechanical means/ bank preparation and excavation	Salt cedar control by spot application of herbicide or cut-stump methods. Mechanical removal would be avoided along river edge and wetlands.
Mowing	2,223	None	Continued annual mowing

4.5 WILDLIFE HABITAT

Effects to wildlife habitat were based on changes in habitat quality after implementing environmental measures. The following evaluation criteria were used for the analyses:

- Changes in habitat quality (WHAP) values; and
- Amount of wetlands and reference community created as a result of implementing environmental measures.

Acreage totals and qualitative vegetation changes were assessed with respect to baseline values. Assumptions regarding future conditions of vegetation due to implementation of environmental measures are provided in the following section.

4.5.1 Method of Analysis

A GIS was used to calculate the extent and location of habitat types. The results of the GIS analyses were assessed against baseline values. Wildlife habitat measured as HU are used to provide a quantitative measure for comparing alternatives. Actions affecting wildlife habitat are reflected as a change (positive or negative) in HU. Changes in HQ

values were calculated by multiplying the HQ difference of the reference community from the baseline community. Although individual wildlife species would respond differently to environmental measures, WHAP provides an overall assessment of the wildlife habitat. To calculate changes in wildlife habitat, the following assumptions were made:

- HQ estimates can be made for reference communities by comparing desired future conditions with WHAP scoring criteria.
- Although there are seral differences in HQ for reference communities, a single HQ value (reference community characteristics after 20 year implementation) is used for assessing changes in baseline values.

Several studies have documented potential increased wildlife value of native communities over invasive salt cedar monocultures (Ellis 1995). Studies at the Bosque del Apache found that reactivation of an abandoned river channel was a key variable in increasing avian richness (Stuart and Farley 1993; Bosque del Apache NWR unpublished biomonitoring program reports). The increase of wildlife response was attributed to developing mesic microhabitats from dryer, less densely vegetated habitats.

Potential WHAP scores were used to reflect the contribution of native plant communities to wildlife habitat quality. Table 4.5-1 presents predicted WHAP values due to implementing environmental measures. The "maximum range" possible column represents the highest hypothetical value for a reference community using the WHAP score sheet. The potential HQ value represents an estimated score for a reference community after 20-year implementation. The potential score is 80 percent of the maximum score. WHAP scoring criteria such as temporal development and uniqueness and relative abundance limit a reference communities' potential HQ value to scores below the maximum score.

Table 4.5-1 Potential Wildlife Habitat Quality From Reference Communities

Reference Community	Potential HQ Value	Maximum Score Range
Improved uplands	0.50	0.63 – 0.88
Improved floodway	0.60	0.75 – 1.0
Native grasslands	0.65	080
Native bosque	0.80	1.0

Assumptions regarding specific calculations effecting wildlife habitat through implementation of environmental measures are listed in the table 4.5-2.

Table 4.5-3 presents baseline values for assessing effects to wildlife habitat. Values are derived from information presented in Section 3 and calculations based on previous assumptions.

Table 4.5-2 Basis for Habitat Quality Calculations

Measure	Effects of ROW Management Categories
Levee rehabilitation	Herbaceous vegetation would be unchanged. Woodlands would decrease an average of 0.65 HQ to 0.36 HQ within levee footprint.
Modified grazing in uplands	Upland leases would increase from an average of 0.3 HQ to 0.5 HQ. Riparian leases would increase from an average of 0.30 HQ to 0.6 HQ.
Modified grassland management in riparian	Riparian vegetation (herbaceous and woody shrub lands) would increase from an average of 0.36 HQ to 0.6 HQ within restoration areas.
Plant woody native vegetation	Floodway vegetation (herbaceous and woody shrub lands) would increase from an average of 0.36 HQ to 0.8 HQ within restoration areas. An initial decrease would occur as a result of measure implementation.
Enhance existing bosques	Increase an average of 0.65 HQ to 0.8 HQ. HQ would initially decrease during measure construction.
Bank shavedowns	Floodway vegetation (herbaceous and woody shrub lands) would increase from an average of 0.36 HQ to 0.8 HQ within restoration areas. HQ would initially decrease during measure construction.
Opening former meanders	Assumed total excavated lands converted at a proportion 50% native bosque (0.8 HQ), 20% wetlands (0.8 HQ), and 30% backwater (pool) habitat. An initial decrease in HQ would occur a result of measure implementation.
Modify dredging at arroyos	Not applicable
Seasonal peak flows /bank preparation	Floodway vegetation (herbaceous and woody shrub lands) would increase from an average of 0.36 HQ to 0.8 HQ within restoration areas. An initial would occur a result of measure implementation. Baseline HQ values were assumed to be comparable to HQ ROW communities.
Conservation easements	A total of 1,618 acres of conservation easements. 771 acres added as restored bosque and wetlands (0.8 HQ). HQ would initially decrease during measure construction. 288 acres added as native grasslands (0.65 HQ), and 559 acres added as existing bosque (no change to HQ).

Table 4.5-3 Baseline Values Used For Analyses

Evaluation Criteria	Upper Rincon	Lower Rincon	Seldon Canyon	Upper Mesilla	Las Cruces	Lower Mesilla	El Paso	Total
WHAP Habitat Units	1021	574	12	303	178	527	330	2945
Wetlands (ac)	54	51	2	15	14	30	11	177
Improved uplands (ac)	0	0	0	0	0	0	0	0
Improved riparian (ac)	0	0	0	0	0	0	0	0
Native bosque or cottonwood / willow riparian community (ac)	0	0	0	0	0	0	0	0
Native grasslands (ac)	0	0	0	0	0	0	0	0

4.5.2 Summary of Effects

Table 4.5-4 presents a summary of the expected effects of the alternative wildlife habitats. Changes from baseline are presented for each evaluation criteria.

Table 4.5-4 Summary of Effects

Evaluation Criteria	No Action	Modified O&M and Flood Control Improvement		Integrated USIBWC Land Management		Targeted River Restoration	
WHAP Habitat Units	2,945	3,822	130%	4,452	151%	5,063	172%
Wetlands (ac)	177	177	nc	190	107%	282	160%
Improved uplands (ac)	nc	1805		1805		1805	
Improved riparian (ac)	nc	1747		1747		1688	
Native bosque or cottonwood / willow riparian community (ac)	nc	nc	nc	350		1549	
Native grasslands (ac)	nc	nc	nc	1641		1929	

nc=no change

4.5.3 No Action Alternative

Under the No Action Alternative, the overall composition of vegetation communities types would remain consistent with current conditions. The general condition of the RGCP would continue to provide poor to below average wildlife habitat. Species adapted to current conditions would continue to thrive with little opportunity for reintroduction of less tolerant species. Overall, no change is expected from baseline conditions

Habitat Quality

No measurable change from the baseline condition would be expected. Decline of isolated native vegetation would not have a measurable effect on total WHAP values. Mowing and grazing would continue to suppress vegetation resulting in limited vegetative structure and HQ scores consistent with poor to below average wildlife quality. Riparian woodlands, invasive dominated or otherwise would provide the highest wildlife habitat quality.

Wetlands and Reference Community Developed

No expected change in condition or extent of wetlands is likely to occur. Little change to the physiognomic characteristics of riparian and upland vegetation would occur. Removal of vegetation by mowing would keep the majority of the floodplain in an early seral community. Riparian woodland would continue to be dominated by salt cedar.

4.5.4 Flood Control Improvement

Under the Flood Control Improvement Alternative, improving lands within grazing leases would increase overall wildlife habitat quality by approximately 30 percent. Continued mowing as a salt cedar control method in areas outside grazing leases would suppress woody growth and maintain a large portion of the floodway in a disturbed or early seral state. The majority of the floodway would be characterized as herbaceous and shrubland (re-growth). Table 4.5-5 presents the Flood Control Improvement Alternative by RMU. Values represent an increase above baseline.

Table 4.5-5 Wildlife Habitat Effects of the Flood Control Improvement Alternative

Evaluation Criteria	Upper Rincon	Lower Rincon	Seldon Canyon	Upper Mesilla	Las Cruces	Lower Mesilla	El Paso	Total
WHAP Habitat Units	401	125	nc	191	41	77	41	877
Wetlands (ac)	nc	nc	nc	nc	nc	nc	nc	nc
Improved uplands (ac)	1,641	164	nc	nc	nc	nc	nc	1,805
Improved riparian (ac)	270	309	nc	638	136	256	138	1,747
Native bosque or cottonwood / willow riparian community (ac)	nc	nc	nc	nc	nc	nc	nc	nc
Native grasslands (ac)	nc	nc	nc	nc	nc	nc	nc	nc

nc=no change

Habitat Quality

Habitat quality would increase 30 percent (Table 4.5-4) from the baseline condition mostly within the Upper and Lower Rincon Valley and Upper Mesilla RMU. The modification of grazing leases would result in an increase of wildlife habitat quality by 877 HU (Table 4.5-5). Mowing would continue to maintain the majority of the ROW as below average quality.

Wetlands and Reference Community Developed

No expected change in extent of wetlands is likely to occur. However, wetlands condition and potential wildlife quality would improve as modified grazing leases would exclude cattle from wetland areas. Although only 177 acres of wetlands were mapped using Parsons (2001b) methodology. National Wetland Inventory maps suggest up to 600 acres of palustrine emergent wetlands could be present in the RGCP. The modified grazing program could result in improvements in wildlife habitat quality for wetlands within the riparian zone.

Modified grazing in the riparian zone would improve vegetation structure and floristic composition, however, non-native Bermudagrass and invasive Russian thistle would likely remain a dominant component of riparian leases. Most of the woody shrubland vegetation within the riparian zone would be cut back annually. Areas inaccessible to mowers would continue to be dominated by salt cedar. Levee construction activities would temporally disrupt some wildlife but not appreciably change

the wildlife habitat condition. Removal of vegetation associated with O&M activities such as mowing would keep the majority of the riparian zone in an early seral state.

4.5.5 Integrated USIBWC Land Management Alternative

Under the Integrated USIBWC Land Management Alternative, modifications to grazing leases and development of native bosque and grasslands would result in a 51% increase in HU. Mowing would continue as the primary salt cedar control method in the lower portions of the RGCP. Species adapted to current conditions would continue to thrive with opportunity for reintroduction of less tolerant species. Levee construction activities would temporally disrupt some wildlife but not measurably change the overall wildlife habitat quality. Table 4.5-6 shows the increase in WHAP HU and habitats above baseline. This change is inclusive of the Flood Control Improvement Alternative.

Table 4.5-6 Wildlife Habitat Effects of the Integrated Land Management Alternative

Evaluation Criteria	Upper Rincon	Lower Rincon	Seldon Canyon	Upper Mesilla	Las Cruces	Lower Mesilla	El Paso	Total
WHAP Habitat Units	645	329	nc	478	188	97	41	1,507
Wetlands (ac)	9	3	nc	nc	nc	nc	nc	13
Improved uplands (ac)	1,641	164	nc	nc	nc	nc	nc	1,805
Improved riparian (ac)	270	309	nc	638	136	256	138	1,747
Native bosque or cottonwood / willow riparian community (ac)	133	61	nc	20	137	nc	nc	350
Native grasslands (ac)	639	611	nc	22	301	68	nc	1,641

nc=no change

Habitat Quality

Wildlife quality would increase over 50 percent (Table 4.5-4). Habitat quality would initially decrease in some locations as environmental measures are implemented, but would increase by 1,507 HU as vegetation develops (Table 4.5-6). Removal of salt cedar may adversely affect wildlife using habitat as food, nesting and /or cover. However, due to the extensive availability of similar woodland (salt cedar) habitat within the RGCP, direct effects would be minor.

Construction activities associated with bank shavedowns would result in the mortality of animals. Such losses would be considered a negligible adverse effect. Levee construction activities would temporally disrupt some wildlife but not appreciably change the wildlife habitat condition.

Salt cedar control and fuel reduction would likely be required in restored bosques to assure native component is sustained. There would be short-term effects due to the disruption or destruction of habitat and foraging areas. However, due to the small acreages treated, in the context of the entire RGCP, the effects would be negligible. Any adverse effects would be minimized or offset by performing treatment (shavedowns, salt cedar control, fuel reduction) out of wildlife breeding seasons. Salt cedar control using

licensed herbicides that are applied in conformance with label instructions would unlikely result in wildlife mortality.

Changes in plant structural characteristics from development of native bosque (350 acres) and native grasslands (1,641 acres) would have a noticeable and long-lasting effect on wildlife quality (Table 4.5-6). Some species would benefit from vegetation changes while others would be adversely affected. Overall, modification of salt cedar control would have a long-term beneficial effect for wildlife.

Wetlands and Reference Community Developed

An increase of 51 percent in HUs would occur due to the development of more structurally diverse vegetation communities including 350 acres of native bosque and 1,641 acres of native grassland (Table 4.5-6). The majority of the change would occur in the Rincon Valley and Upper Mesilla RMU. Wildlife adapted to current conditions would continue to thrive. Long-term wildlife composition would either remain unchanged or would gradually change in response to changes in habitat conditions. The changes would be considered a minor direct effect. Depending on prevailing land management objectives slight shifts in species assemblages could be considered either adverse or beneficial.

A seven percent increase in wetlands would occur due to bank shavedowns (Table 4.5-6). Overall wetlands condition and potential wildlife quality would improve as the majority of the floodway would be managed as modified grazing leases, native grasslands or native bosque. The environmental measures would likely result in improvements of emergent wetlands and subsequent increased wildlife habitat quality.

Modified grazing in the riparian zone would improve vegetation structure and species diversity, however, non-native Bermudagrass and invasive Russian thistle would likely remain a dominant component of 1,747 acres of riparian leases. Most of the woody shrubland vegetation within the floodway would be cut back annually.

4.5.6 Targeted River Restoration Alternative

Under this alternative, wildlife habitat quality would increase 72% (Table 4.5-4) as a result of implementing environmental measures and modifying invasive species control methods. The addition of 1,618 acres of conservation easements (Table 4.5-2) would increase the amount of native vegetation and preserve river corridor in the Rincon Valley and Upper Mesilla RMU. The potential development of 1,549 acres of native bosque and 1,929 acres of native grassland would have a positive effect for wildlife (Table 4.5-7).

Mowing would continue as the primary salt cedar control method in the lower portions of the RGCP but restricted to the levees in the Rincon Valley. The majority of the riparian zone would be characterized as grassland with native riparian woodland established in the Rincon Valley, Seldon Canyon and Upper Mesilla RMU. Species adapted to current conditions would continue to thrive with opportunity for reintroduction of less tolerant species. The Rincon Valley, Seldon Canyon and Upper Mesilla RMU would have the greatest potential for reintroduction of wildlife species less tolerant of

current management practices. Levee construction activities would temporally disrupt some wildlife but not measurably reduce overall wildlife quality.

Table 4.5-7 shows the increase above baseline for the WHAP HU and increases in area for wetlands and reference habitats. These changes are inclusive of Integrated Land Management Alternative.

Table 4.5-7 Wildlife Habitat Effects of the Targeted River Restoration Alternative

Evaluation Criteria	Upper Rincon	Lower Rincon	Seldon Canyon	Upper Mesilla	Las Cruces	Lower Mesilla	El Paso	Total
WHAP Habitat Units	720	576	192	210	188	170	61	2,118
Wetlands (ac)	25	21	32	4	17	3	4	106
Improved uplands (ac)	1641	164	0	0	0	0	0	1805
Improved riparian	286	242	nc	635	131	256	138	1,688
Native bosque or cottonwood/willow riparian community (ac)	303	537	351	10	137	168	44	1,549
Native grasslands (ac)	639	743	128	50	301	68	8	1,929

Habitat Quality

Changes in plant communities would have a noticeable effect on wildlife quality. A 72 percent increase in HUs would occur due to the development of native vegetation communities, modifications in grazing management of conservation easements (Table 4.5-4). The majority of the change would occur in the Rincon Valley, Seldon Canyon and Lower Mesilla Valley. Habitat quality would initially decrease as environmental measures are implemented but would increase as reference communities develop. Long-term wildlife composition would either remain unchanged or would gradually change in response to changes in habitat conditions. Depending on prevailing land management objectives slight shifts in species assemblages could be considered either adverse or beneficial.

Construction associated with environmental measures and removal of salt cedar may adversely affect wildlife using habitat as food, nesting and/or cover. Because of the extensive availability of similar woodland habitat in the RGCP, direct effects would be minor. There would be short-term effects of construction or salt cedar control treatment due to the disruption or destruction of habitat and foraging areas. Any adverse effects would be minimized or offset by performing the treatment actions out of wildlife breeding seasons. Overall, modifications of salt cedar control methods would have a long-term beneficial effect for wildlife.

Wetlands and Reference Community Developed

A 60 percent increase in wetlands would occur as a result of opening former meanders and management of conservation easements supporting wetlands communities (Table 4.5-4). Overall wetlands condition and potential wildlife quality would improve as the majority of the floodway would be managed as modified grazing leases, native

grasslands or native bosque. The environmental measures would likely result in measurable improvements in wildlife quality.

Managed overbank flows in conjunction with bank preparation would slightly increase native vegetation within the Rincon Valley. The addition of conservation easements would extend riparian restoration throughout the RGCP. As a result of overbank flows, planting and conservation easements, the Upper Rincon (720 HU) and Lower Rincon (576 HU) would exhibit the most significant increases in habitat quality of the entire RGCP (Table 4.5-7). Overall, the RGCP would show an increase of 2,118 HU due to the implementation of environmental measures. The replacement of mowed acreage with high quality bosques and grassland is reflected in increase WHAP scores.

Salt cedar control would be required to assure the native dominated component is maintained. Fuel reduction would likely be required in bosque restoration sites. The majority of riparian restoration projects would be dominated by young - mid aged native vegetation. Salt cedar treatments would result in direct minor effects to wildlife in treatment areas. Any adverse effects could be minimized through mitigation measures.

4.6 ENDANGERED AND THREATENED SPECIES OF CONCERN

Threatened and endangered species and species of special concern populations would be expected to increase or decrease depending on availability of suitable habitat. Currently, suitable habitat for listed species is largely absent in the RGCP. However, habitat improvements could potentially result in the development of suitable endangered and special status species habitat. The following evaluation criteria were used to evaluate the effects of alternatives on endangered species and species of concern.

- Amount of reference community developed as a result of implementing environmental measures; and
- Construction activities associated with environmental measures and O&M activities.

4.6.1 Method of Analysis

Effects to threatened and endangered species were based on assessing species life history requirements with reference community characteristics and construction activities associated with environmental measures. For those species with no potential habitat in the RGCP (as determined from literature review and field survey results) the determination of "no-effect" was applied. For those species with potential habitat in the RGCP, O&M activity and environmental measures associated with alternatives were assessed to determine potential effects. The potential effects of O&M activities and environmental measures on T&E species with a potential habitat in the RGCP are presented in Table 4.6-1.

Table 4.6-1 Potential Effect of O&M Activities and Environmental Measures on Listed Species

O&M Activity / Environmental Measure*	Alternative	Potential Effect to Listed Species with a Potential Habitat in the RGCP
Current O&M activities	NA, FCI, IULM, TRR	Long-term sediment removal/ disposal operations, channel bank protection and road maintenance are conducted. Sediment removal and channel bank protection occurs infrequently (minimal since 1961). Road maintenance occurs on a less then annual basis. Vegetation management by mowing either on USIBWC maintained areas or leased areas is conducted on an annual basis. Maintenance activities could potentially create short-term noise disturbance to interior least terns and bald eagles within RGCP.
Levee rehabilitation	FCI, IULM, TRR	Activities could potentially create short-term noise disturbance to infrequent migrant use by the interior least terns and bald eagle.
Modify grazing practices	FCI, IULM, TRR	No likely benefit as a result of implementing this measure
Modified grassland management in floodway	IULM, TRR	No likely benefit as a result of implementing this measure
Plant woody vegetation and/or enhance bosques	IULM, TRR	No likely benefit within 20-year implementation period.
Bank shavedowns	IULM	Earthwork and related construction activities could potentially create short-term noise disturbance to interior least terns and bald eagles infrequently over-wintering within RGCP. Development of riparian woodlands in conjunction with potential moist soil conditions as a result of bank shavedowns could create suitable nesting conditions for southwestern willow flycatcher nesting habitat. The lowering of banks would have a potential of creating interspersed wetlands and or moist soil conditions within the restoration areas. This combination of wetlands/wet conditions in conjunction with riparian development could result in long-term beneficial effects to southwestern willow flycatcher habitat. No likely benefit to bald eagles within 20-year implementation period would be expected.
Open former meanders	TRR	Earthwork and related construction activities could potentially create short-term noise disturbance to interior least terns and bald eagles infrequently over-wintering within RGCP. Development of riparian woodlands in conjunction with potential moist soil conditions as a result of opening former meanders could create suitable nesting conditions for southwestern willow flycatcher nesting habitat. The opening of meanders would have a potential of creating interspersed wetlands and or moist soil conditions within the restoration areas. This combination of wetlands/wet conditions in conjunction with riparian development could result in long-term beneficial effects to southwestern willow flycatcher habitat. No likely benefit to bald eagles within 20-year implementation period would be expected.
Modify dredging at arroyos by creating embayments	TRR	No likely benefit as a result of implementing measure within 20-year implementation period. Dredging activities could potentially create short-term noise disturbance to interior least terns and bald eagles that infrequently over-winter within the RGCP.
Seasonal peak flows	TRR	No likely benefit as a result of implementing measure within 20-year implementation period would be expected.
Conservation easements	TRR	Management of conservation estimates could potentially benefit listed species. However, if suitable habitat currently exits in some conservation easements (i.e. those located in Seldon Canyon), implementation of measure (*i.e.,* salt cedar reduction) could adversely effect southwestern willow flycatcher habitat. Therefore, surveys would be conducted within conservation easements prior to environmental measure implementation. No likely benefit to bald eagles within 20-year implementation period would be expected.

* NA- No Action; FCI, Flood Control Improvement; IULM, Integrated USIBWC Land Management; TRR, Targeted River Restoration

Effect determinations were assessed by determining the presence or absence of T&E habitat and if present, analyzing the potential effects of alternative measures. Effect determination for each listed species was based on the following definitions:

"*No effect*" – Either the T&E species habitat was not present in the RGPC and/or the alternative would have no effect on available T&E species habitat.

"*May affect – is not likely to adversely affect*" – T&E species habitat or T&E individuals could potentially be present in the RGPC and the alternative would have beneficial, insignificant or discountable effects.

"*May affect – is likely to adversely affect*" – T&E species habitat or T&E individuals could potentially be present in the RGPC and the adverse effects can not be avoided.

4.6.2 Summary of Potential Effects

Table 4.6-2 presents a summary of reference community development for each alternative. Potential effects could be short-term and direct as a result of construction activities and/or long-term as a result of restoring and improving riparian habitats. Currently, suitable habitat for listed species is largely absent in the RGCP. However, environmental measures could potentially result in development of suitable habitat. Specifically, measures associated with the Integrated USIBWC Land Management Alternative and Targeted River Restoration Alternative could potentially result in future vegetation communities consistent with T&E habitat. Assumptions regarding the potential customization of reference community as a result of implementing environmental measures are shown in Table 4.6-3.

Table 4.6-2 Summary of Reference Community Development for T&E Species

Evaluation Criteria	No Action Alternative	Flood Control Improvement Alternative	Integrated USIBWC Land Management Alternative	Targeted River Restoration Alternative
Improved uplands (ac)	nc	1805	1805	1805
Improved riparian (ac)	nc	1747	1747	1688
Native bosque or cottonwood/willow riparian community (ac)	nc	0	350	1549
Native grasslands (ac)	nc	0	1641	1929

nc=no change

Table 4.6-3 Assumptions Regarding T&E Species for Reference Communities

Species	Improved Uplands	Improved Riparian	Native Bosque or Cottonwood/Willow riparian community	Native Grasslands
Interior Least Tern	No likely benefit	No likely benefit	No likely benefit	No likely benefit
Southwestern Willow Flycatcher	No likely benefit	No likely benefit	Potential benefit assuming suitable hydrologic regime	No likely benefit
Bald Eagle	No likely benefit	No likely benefit	No likely benefit during the analyses period	No likely benefit
Piping Plover	No likely benefit	No likely benefit	No likely benefit	No likely benefit
Whooping Crane	No likely benefit	No likely benefit	No likely benefit	No likely benefit

4.6.3 No Action Alternative

Currently, suitable habitat for all but three listed species (piping plover, bald eagle, and interior least tern) is absent from the RGCP. Although piping plover habitat is potentially present, the migrant status of the piping plover and the lack of sighting within the RGCP result in a "no-effect" determination. For the bald eagle and interior least tern, O&M practices associated with the no-action alternative result in a "may affect – is not likely to adversely affect" determination. Current condition do not provide suitable habitat for endangered species.

4.6.4 Flood Control Improvement Alternative

Under the Flood Control Improvement Alternative, there would be no direct effects to threatened an endangered species. Suitable habitat for all but three listed species (piping plover, bald eagle, and interior least tern) would continue to be absent from the RGCP. Although piping plover habitat is potentially present, the migrant status of the piping plover and the lack of sighting within the RGCP result in a "no-effect" determination. For the bald eagle and interior least tern, O&M practices associated with the flood control improvement alternative result in a "may affect – is not likely to adversely affect" determination. Direct effects to SOCs known to occur in the area (western burrowing owl and white-faced ibis) or potentially occurring would be negligible. (See Table 3.6.3 for listing of SOCs).

Reference communities developed by this alternative include improved uplands and improved riparian (Table 4.6-4). There would be no indirect effects to threatened and endangered species. The SOCs potentially benefiting from the development of 1,805 acres of improved uplands and improved riparian include the loggerhead shrike (Table 3.6.3). Reference community for improved uplands and improved riparian is consistent with habitat requirements of the loggerhead shrike

Table 4.6-4 Summary Reference Community Development for Flood Control Improvement Alternative

Evaluation Criteria	Upper Rincon	Lower Rincon	Seldon Canyon	Upper Mesilla	Las Cruces	Lower Mesilla	El Paso	Total
Improved uplands (ac)	1641	164	nc	nc	nc	nc	nc	1805
Improved riparian (ac)	270	309	nc	638	136	256	138	1747
Native bosque or cottonwood/willow riparian community (ac)	nc	nc	nc	nc	nc	nc	nc	nc
Native grasslands (ac)	nc	nc	nc	nc	nc	nc	nc	nc

nc=no change

4.6.5 Integrated USIBWC Land Management Alternative

Under the Integrated USIBWC Land Management Alternative, there would be no direct effects to threatened an endangered species. Suitable habitat for four listed species (piping plover, bald eagle, interior least tern, and southwestern willow flycatcher) would be potentially present within the RGCP. Although piping plover habitat is potentially present, the migrant status of the piping plover and the lack of sighting within the RGCP result in a "no-effect" determination. O&M practices associated with the Integrated USIBWC Land Management alternative may result in a "may affect – is not likely to adversely affect" determination for the bald eagle and interior least tern. Direct effects to SOCs known to occur in the area (western burrowing owl and white-faced ibis) would be negligible.

Reference communities developed by this alternative include improved uplands, improved riparian, native bosque and native grasslands (Table 4.6-4). Development of native riparian woodlands could create conditions suitable for southwestern willow flycatcher nesting habitat. The lowering of banks would have a potential of creating interspersed wetlands and or moist soil conditions within the restoration areas. This combination of wetlands/wet conditions in conjunction with riparian development could result in long-term beneficial effects to southwestern willow flycatcher habitat. As a result a "may affect – is not likely to adversely affect" determination was made for the southwestern willow flycatcher under the Integrated USIBWC Land Management Alternative.

Table 4.6-5 Summary of Reference Community Development for Integrated USIBWC Land Management Alternative

Evaluation Criteria	Upper Rincon	Lower Rincon	Seldon Canyon	Upper Mesilla	Las Cruces	Lower Mesilla	El Paso	Total
Improved uplands (ac)	1641	164	nc	nc	nc	nc	nc	1805
Improved riparian (ac)	270	309	nc	638	136	256	138	1747
Native bosque or cottonwood/willow riparian community (ac)	133	61	nc	20	137	nc	nc	350
Native grasslands (ac)	639	611	nc	22	301	68	nc	1641

nc=no change

Species of concern potentially benefiting from environmental measures include the loggerhead shrike, northern gray hawk, Arizona southwestern toad, and desert viceroy butterfly. The reference community for improved riparian, uplands, and native grasslands is consistent with habitat requirements of the loggerhead shrike. The reference community for native bosque is consistent with habitat requirements of northern gray hawk, Arizona southwestern toad and desert viceroy butterfly (Table 3.6.3).

4.6.6 Targeted River Restoration Alternative

Under the Targeted River Restoration Alternative, there would be no direct effects to threatened an endangered species. Direct effects to SOCs known to occur in the area (western burrowing owl and white-faced ibis) would be negligible. Suitable habitat for four listed species (piping plover, bald eagle, interior least tern, and southwestern willow flycatcher) would be potentially present within the RGCP. Although piping plover habitat is potentially present, the migrant status of the piping plover and the lack of sighting within the RGCP result in a "no-effect" determination. O&M practices associated with the Targeted River Restoration Alternative may result in a "may affect – is not likely to adversely affect" determination for the bald eagle and interior least tern. Reference communities developed by this alternative include improved uplands, improved riparian, native bosque and native grasslands (Table 4.6-6). Development of riparian woodlands as a result of opening meanders could create conditions suitable for southwestern willow flycatcher nesting habitat. The opening of meanders would have a potential of creating interspersed wetlands and or moist soil conditions within the restoration areas. This combination of wetlands/wet conditions in conjunction with riparian development could result in long-term beneficial effects to southwestern willow flycatcher habitat.

In addition, implementation of the conservation easements could potentially benefit the southwestern willow flycatcher. However, if suitable habitat currently exits in some conservation easements, measure implementation (i.e., salt cedar reduction) could adversely affect the species habitat. Although there is a potential likelihood of southwestern willow flycatcher habitat within conservation easements (primarily within Seldon Canyon), a determination of "may affect – is not likely to adversely affect" is made under the mitigation conditions dicussed at the end of this chapter.

Species of concern (Table 3.6.3) potentially benefiting from environmental measures include the loggerhead shrike, northern gray hawk, Arizona southwestern toad and desert viceroy butterfly. The reference community for improved uplands/floodway and native grasslands is consistent with habitat requirements of the loggerhead shrike. The reference community for native bosque is consistent with habitat requirements of northern gray hawk, Arizona southwestern toad and desert viceroy butterfly. The status of listed species in potential conservation easements in unknown. Management of construction estimates could potentially benefit listed species. However, if suitable habitat currently exits in some conservation easements, implementation of measure (i.e.,

salt cedar reduction) could adversely effect listed species habitat. Therefore, surveys would be conducted within conservation easements prior to environmental measure implementation.

Table 4.6-6 Summary of Reference Community Development for Targeted River Restoration Alternative

Evaluation Criteria	Upper Rincon	Lower Rincon	Seldon Canyon	Upper Mesilla	Las Cruces	Lower Mesilla	El Paso	Total
Improved uplands (ac)	1641	164	nc	nc	nc	nc	nc	1805
Improved riparian (ac)	286	242	nc	635	131	256	138	1688
Native bosque or cottonwood/willow riparian community (ac)	303	537	351	10	137	168	44	1549
Native grasslands (ac)	639	743	128	50	301	68	nc	1929

nc=no change

4.7 AQUATIC BIOTA

Alternative effects to aquatic habitats were based upon changes to the amount of in-channel habitat, backwater habitat, and a habitat units of largemouth bass and flathead catfish. These fish are long-lived predators that would only be successful in a river with an adequate food supply and spawning and rearing habitat. The following evaluation criteria were used for the analyses:

- In-channel habitat, a representation of conditions along the overall length of the RGCP.
- Created backwater habitat established as a result of habitat modifications within the RGCP.
- Habitat suitability for indicator two fish species for largemouth bass and flathead catfish, as indicated by HEP evaluation methodology.

4.7.1 Method of Analysis

Acreage totals and qualitative habitat changes for each alternative were compared to baseline values. The analyses assessed changes in aquatic habitat as a result of implementing environmental measures. Analysis assumptions included:

- The current anthropomorphic factors would continue to be the dominating influence. Specifically the altered hydrologic and sediment regime would remain in place through the analysis period.
- The location and amount of unconsolidated shore habitat and open water habitat are dynamic and change to reflect flow conditions.
- The calculated HEP scores for two species, largemouth bass and flathead catfish, are reflective of aquatic habitat conditions in the RGCP in terms of availability of suitable, dependable prey source and spawning and rearing habitat.

- Modifications of land management practices would eventually be reflected by increases in the quality of aquatic habitat.

Reference communities are the result of implementing environmental measure and represent the "desired" future condition of aquatic habitat. The two aquatic reference communities identified are 1) back water habitat, and 2) main river run. Table 4.7-1 lists HSI associated with reference communities.

Table 4.7-1 Habitat Suitability Indices for Largemouth Bass and Flathead Catfish

Environmental Measure	Largemouth Bass HSI	Flathead Catfish HSI	Reference Community
Modified grazing leases (riparian zone)	0.05	0.25	Main river run with increase riparian cover and bank stability for river margin.
Modified grassland management	0.05	0.25	Main river run with increase riparian cover and bank stability for river margin.
Native vegetation planting	0.05	0.25	Main river run with increase riparian cover and bank stability for areas adjacent to river.
Bank shavedowns	0.05	0.25	Main river run with increase riparian cover and bank stability.
Existing bosque enhancement	0.05	0.25	Main river run with increase riparian cover and bank stability.
Seasonal peak flows /bank preparation	0.05	0.25	Main river run with increase riparian cover and bank stability.
Excavation of arroyos	0.15	0.45	Backwater habitat with increased Pool Depth.
Reopening former meanders within ROW	0.15	0.45	Backwater habitat increased Pool Depth and increase riparian cover and bank stability.

4.7.2 Summary of Potential Effects

Table 4.7-2 presents a summary of alternative effects on aquatic habitat. The summary lists acreage of habitat and associated HU for the largemouth bass and flathead catfish.

Table 4.7-2 Summary of Alternative Effects on Aquatic Habitat

Evaluation Criteria	No Action Alternative		Flood Control Improvement Alternative		Integrated USIBWC Land Management Alternative		Targeted River Restoration Alternative	
	Units	Change	Units	Change	Units	Change	Units	Change
In-channel habitat (acres)	2,513	nc	2,513	nc	2,513	nc	2,513	nc
Created backwater habitat (acres)	nc	nc	nc	nc	nc	nc	59	Additional habitat
HEP largemouth bass (HU)	126	nc	126	nc	126	nc	134	6.3%
HEP flathead catfish (HU)	628	nc	628	nc	628	nc	654	4.1%

4.7.3 No Action Alternative

Under the No Action Alternative, vegetation community and vegetation management would remain consistent with current conditions. Long-term effects are a continued fragmentation of aquatic habitat due to unnatural flow regimes, reduced riparian vegetation, and low physical stream habitat diversity.

4.7.4 Flood Control Improvement Alternative

Direct effects due to levee rehabilitation would be short-term resulting in the removal of vegetation and the replacement of effected areas by vegetated levees. Construction of some levees may reduce the amount of runoff into the river. This effect would be localized.

The modification of grazing leases may lead to a reduction of sediment runoff nitrogenous contaminants from livestock. This would represent a localized effect and may improve water quality in some instances. Modification of floodway grazing leases could lead to some increase in bank stabilization and overhanging cover in localized situations. Long-term, this would increase shading along the river, and potentially increase invertebrate production near the river. No change in HU for largemouth bass or flathead catfish would occur.

4.7.5 Integrated USIBWC Land Management Alternative

Direct effects due to levee rehabilitation and grazing leases modification would be similar to those indicated for the Flood Control Improvement Alternative.

Bank shavedowns, associated with episodic over bank flows, could potentially influence fish during their spawning periods by providing additional spawning and resting habitats, particularly if small side channels or embayments were created as a result of the activity. Increase in overhanging cover from bosque development and improved river margin vegetation within native grasslands would likely have a long-term beneficial effect to aquatic species.

4.7.6 Targeted River Restoration Alternative

Direct effects due to levee rehabilitation and grazing lease modification would be similar to the previous action alternatives.

This alternative offers the greatest opportunity for the improvement of aquatic habitat. Modification of the terrestrial system, and links to the aquatic system would result in long-term beneficial effects to the aquatic system. Specifically, direct effects include the opening of stream meanders within the ROW for 122 acres within the Upper Rincon area and about 20 acres within the Upper Mesilla area (Table 4.7-2). Modified dredging in some arroyos for aquatic habitat diversification would occur within the Upper Rincon area (2.62 acres) and Lower Rincon area (4.2 acres). This activity would create some diversity of aquatic habitat in a localized manner, and provide backwater areas for fish species. A total of 59 acres of aquatic habitat would be developed (Table 4.7-2).

These activities would increase the amount and size of pools within these areas thus increasing resting and feeding habitat. As a result of aquatic habitat diversification, largemouth bass and flathead catfish HEP values show an increase of 6.3% and 4.1%, respectively.

The development of native bosque and native grasslands within the riparian community would likely result in long-term beneficial effects to aquatic resources. Beneficial effects include increased bank stabilization, overhanging cover along the river margin, invertebrates food production, and improved water quality. Improving the terrestrial/aquatic link would result in increased aquatic habitat diversity.

The development of backwater habitat would increase largemouth bass HUs to 134 and flathead catfish to 654 (Table 4.7-2). Improvements within the bosque would directly improve bank stabilization and vegetation establishment, thus providing shading, invertebrate food production, and increased bank overhead cover for aquatic species in these areas. This process, by improving the terrestrial/aquatic link, would result in long-term beneficial effects by increasing habitat diversity.

Habitat is more than a physical place for the fish to occur, there must be areas of suitability for reproduction, rearing of young, and the production of adequate food sources. Environmental measure could increase the amount and size of pools within the RGCP thus increasing resting and feeding habitat for the largemouth and flathead catfish, the HEP evaluated species, as well as other species, particularly if the pools occur near the river bank. Indirectly, increasing the amount and depth of pools, by increasing the diversity of river habitats, will improve aquatic productivity in the areas where the planned meandering and dredging is planned.

4.8 LAND USE

The following evaluation criteria were used in the analysis of river management alternatives effects on land use:

- Changes in agricultural land use
- Changes in recreational use

4.8.1 Method of Analysis

Land use analysis is limited to lands outside the USIBWC jurisdiction, in terms of agricultural use. Land use changes within the ROW evaluated in this section are those associated with recreational use. For recreational use, the same initiatives apply to all alternatives, so no analysis is conducted for individaul alternatives. Effects on other resources (soils, vegetation, wildlife habitat) were previously evaluated (Subsections 4.3 through 4.7).

Potential changes in land use would be associated with voluntary conservation easements and, to a lesser extent, with material borrow sites needed for levee rehabilitation. A second type of change, farmland retirement, could also result from water acquisition for implementation of environmental measures. For water acquisition

two scenarios were evaluated. Under the Scenario 1, water would be acquired by financing on-farm water conservation programs. This approach is the preferred strategy as it would retain farmlands in full production (Subsection 2.2.9).

Under Scenario 2, landfarm retirement would be required for direct water acquisition. The extent of potential farm retirement was calculated based on the alternative estimated water consumption. Acreage of retired farmland was estimated by dividing water consumption (ac-ft/yr) by the typical Rio Grande Project water allocation (3 ft/yr). In this estimate it is assumed that surface water sources would supply the entire water requirement, without a groundwater contribution. This is a conservative approach as established vegetation in the floodway is expected to be sustained primarily by groundwater.

4.8.2 Summary of Potential Effects

Table 4.8-1 presents a comparative summary of potential effects of river management alternatives under consideration on land use.

Implementation of either the three river management action alternatives or the No Action Alternative would not result in adverse effects on recreational resources. The USIBWC, along with other agencies who manage and maintain projects along the RGCP, are currently participating in initiatives to create additional recreational opportunities and public access to natural areas within the Rio Grande floodway. As a result, projects currently underway and future ROW enhancements identified would result in the same beneficial effects to recreational resources under all alternatives.

Table 4.8-1 Summary of Potential Effects on Land Use

Evaluation Criteria	No Action Alternative	Flood Control Improvement Alternative	Integrated USIBWC Land Management Alternative	Targeted River Restoration Alternative
Changes in agricultural land use	No effect	Approximately 50 acres of agricultural land would be needed as material borrow sites to raise or build levees	50 acres of agricultural land would be needed as borrow sites. Without an on-farm water conservation program, environmental measure Implementa-tion could result in 734 acres of cropland retirement	Voluntary conservation easements would affect up to 288 acres of cropland. Current use would be maintained for another 1,330 acres of remnant bosque easements. Without an on-farm water conservation program, environmental measure implementation could result in 3,154 acres of cropland retirement
Changes in recreational use	Beneficial effects on recreational resources	Same as No-Action Alternative	Same as No-Action Alternative	Same as No-Action Alternative

4.8.3 No Action Alternative

Under the No Action Alternative, the RGCP operation and maintenance would not change from the current practices. Agricultural land use in the potential area of influence

would remain unaffected relative to current conditions. Beneficial effects on recreational use as ongoing initiatives are implemented.

4.8.4 Flood Control Improvement Alternative

Under this alternative, levee rehabilitation would be the only action with potential effects on land use adjacent to the RGCP. While levee construction would take place in government lands, it was estimated that up to 149 acres of material borrow sites would be needed for rehabilitation of the levee system if adequate material were available within the ROW. The estimated depth of excavation is 6 feet.

Rehabilitation estimates include six miles of new levees and increasing levee height up to 2 feet for 60.1 miles. The bulk of the rehabilitation program would take place in the southern reaches of the RGCP, 90 percent of the new levees would be within El Paso RMU, and 64 percent of the height increase would take place in the El Paso and Las Cruces RMUs. Because most of the levee rehabilitation would take place near urban areas, most borrow material would likely to be obtained from commercial sites already in operation. The combined length of levee rehabilitation outside the El Paso and Las Cruces RMUs would be 22.2 miles, or 33.6 percent of the entire rehabilitation program. On this basis, up to 50 acres of the approximately 149 acres of borrow sites would be located in agricultural areas. Relative to the 30,289 acres located within the area of influence (Table 3.8-1), it would not be significant in terms of land use.

4.8.5 Integrated USIBWC Land Management Alternative

This alternative would include the same construction activities as the Flood Control Improvement Alternative. In addition to these construction activities, the Integrated USIBWC Land Management Alternative would include habitat enhancement through management of bosque, planting of native vegetation, regeneration of native woody vegetation, and improvement of erosion control. These activities would occur entirely within the RGCP, without changesd in current land use outside the ROW. These activities would be compatible with and would not change existing land use.

No changes in land use would be anticipated under the preferred water acquisition Scenario 1, financing of on-farm conservation programs. Under Scenario 2, direct water acquisition (or groundwater use) would be required to support implementation of environmental measures. For an estimated water consumption of 2,203 ac-ft/yr (Table 4.1-4), and an annual 3 ac-ft/ac allocation, a 734-acre farmland retirement would be required for water consumption under the Integrated USIBWC Land Management Alternative). Relative to 19,020 acres of agricultural lands located within the potential area of influence (Table 3.8-1), retired farmlands would represent 3.9 percent.

Some USIBWC lands near urban areas would be allocated for recreational use. These areas include designated parklands that would be extended under all river management alternatives under consideration. These activities would be compatible with current land uses, and would have the same effects as the No Action Alternative.

4.8.6 Targeted River Restoration Alternative

This alternative would include the same construction activities as the Flood Control Improvement Alternative for levee system rehabilitation. The Targeted River Restoration Alternative would also include a total of 1,618 acres of voluntary conservation easements outside the ROW. Of these easements 1,330 acres are existing bosques located primarily in Seldon Canyon that would be preserved as part of the Targeted River Restoration Alternative. The remaining 288 acres are croplands that would be converted to conservation easements. Voluntary easements would be established for a vegetation management program. Ownership of these properties would not change; only the function of the land through voluntary easements.

No additional changes in land use would be anticipated under the preferred water acquisition Scenario 1, financing of on-farm conservation programs. Under Scenario 2, direct water acquisition (or groundwater use) would be required to support implementation of environmental measures. The estimated water consumption for the Targeted River Restoration Alternative would be 9,461 ac-ft, 78 percent of which would be associated with controlled water releases from Caballo Dam in early spring to induce overbank flows (Table 4.1-5). On the basis of a 3 ac-ft/ac annual allocation, a farmland retirement of 3,154 acres would be required for water consumption under the alternative. Relative to 19,020 acres of agricultural lands located within the potential area of influence (Table 3.8-1), retired farmlands would represent 16. 6 percent.

Some USIBWC lands near urban areas would be allocated for recreational use under all river management alternatives under consideration. These areas include designated parklands that would be extended. These activities would be compatible with current land uses, and would have the same effects as the No Action Alternative.

4.9 SOCIOECONOMIC RESOURCES AND ENVIRONMENTAL JUSTICE

The following evaluation criteria were used in the analysisof the effects of levee construction and river management alternatives on socioeconomic resources and environmental justice:

- Changes in population and housing;
- Changes in employment;
- Changes in income;
- Changes in business volume;
- Disproportionate number of minority populations affected;
- Cropland lost;
- Value of cropland production lost; and
- Decrease in farm laborers.

4.9.1 Method of Analysis

The Economic Impact Forecast System (EIFS) Model was used to project the short-term regional and local economic impacts of levee construction. The EIFS Model was developed by the U.S. Army Construction Engineering and Research Laboratory (CERL) to provide a systematic method for evaluating regional socioeconomic effects of government actions. Using employment and income "multipliers" developed with a comprehensive regional/local database combined with economic export base techniques, the model estimates the direct and indirect economic impacts of a construction activity on changes in the regional/local population and housing; employment; business volume; and income. The Region of Influence (ROI) is considered to be Doña Ana County and Sierra County in New Mexico, and El Paso County in Texas. Since the EIFS economic projections are on an annual basis, the primary model input for levee construction costs ($18.7 million) was pro-rated over a five-year construction period. In addition, an estimate of 42 construction workers was also used as an input into the model. Table 4.9-1 summarizes the economic impacts under each alternative as forecasted by the EIFS Model.

The EIFS Model also includes a RTV (Rational Threshold Value) profile that is used in conjunction with the forecast model to assess the significance of impacts of a construction activity for a specific geographic area or region. For each variable (i.e. population, housing, employment, business volume, income) the current time-series data available from the Bureau of Economic Analysis is calculated along with the annual change, deviation from the average annual change, and the percent deviation for each variable. This calculation defines a "threshold" for significant annual economic impacts for a variable. If the RTV for a particular variable associated with the impacts of the project exceeds the annual regional RTV for that variable, then the economic impact is considered to be significant. If the RTV for a variable is less than the regional RTV for that variable, the regional economic impact is then considered not significant.

The implementation and operational effects of the proposed management activities under each alternative were analyzed using a different methodology. The objective of this analysis was to estimate the impacts on cropland reduction as a result of levee borrow sites, conservation easements, and direct water rights acquisition. These impacts include acreage of cropland lost, annual value of cropland production lost, and associated decrease in farm laborers under each of the alternatives and associated components/scenarios.

This latter analysis was based on estimates of cropland distribution by type, and per acre value of annual production for the project area. Because of cropland similarities, the cropland distribution for the Elephant Butte Irrigation District (EBID), excluding pecans, was used and pro-rated for each alternative and associated component/scenario. Estimates of annual value of production per acre for each crop was obtained from the New Mexico Department of Agriculture, Agricultural Statistics Service; U.S. Department of Agriculture, U.S. Census of Agriculture, 1997; and economic worksheets developed for the El Paso-Las Cruces Regional Sustainable Water Project (CH2M-Hill 2000b). In addition, an estimate was made of the direct impact on farm labor as a result of the removal of cropland from production. This estimate was based on the average number of

acres per farm worker in Doña Ana County according to the U.S. Census of Agriculture. This value was subsequently inflated to reflect the more labor-intensive character of some of the crops grown in the affected area.

4.9.2 Summary of Potential Effects

Levee System Improvements

Table 4.9-1 presents a comparative summary of potential effects of river management alternatives under consideration on socioeconomic resources and environmental justice. Table 4.9-1 summarizes the impacts of levee construction under each alternative in respect to changes in population/housing, employment, business sales volume, income and disadvantaged populations. Table 4.9-2 summarizes the implementation/operational impacts of each of the components/scenarios under each alternative on potential cropland removed from production, value of cropland production, and farm labor.

Table 4.9-1 Summary of Potential Effects on Socioeconomic Resources and Environmental Justice, Levee Construction

Evaluation Criteria	No Action Alternative	Flood Control Improvement Alternative	Integrated USIBWC Land Management Alternative	Targeted River Restoration Alternative
Changes in population and housing	No change	No change	No change	No change
Direct/Indirect changes in employment	No change	104 additional short-term jobs	104 additional short-term jobs	104 additional short-term jobs
Annual direct/indirect changes in sales volume	No change	$12, 267,200	$12, 267,200	$12, 267,200
Direct/Indirect changes in income	No change	$2,194,432	$2,194,432	$2,194,432
Disproportionate number of low-income / minority populations negatively affected	No change	No effect	No effect	No effect

The socioeconomic impacts of levee construction presented in Table 4.9-1 represent the outputs from the EIFS Model. It was assumed that the majority of the expenditures associated with levee construction would be local expenditures. Since the estimated cost of levee construction is the same under each alternative, the socioeconomic impacts are also similar for each alternative. A total of 104 direct and indirect jobs would be created, including the 42 construction jobs associated with the construction of the levee. Other jobs created include those directly or indirectly associated with levee construction, including jobs in the various industry sectors such as retail/wholesale trade, construction, manufacturing. Other impacts include an annual increase of $12,267,200 in direct and indirect business sales volume, and an annual increase of $2,194,432 in direct and indirect income. The RTV values generated from

the EIFS Model for each of the economic variables associated with levee construction were significantly below the regional RTV values for each variable. Thus, this construction activity is not considered to have significant regional/local economic impacts.

There would be no changes in population or housing as it is assumed that all of the construction workers would come from the local or regional labor pool. There would be no disproportionate adverse impact on minority or low-income populations. Rather, considering the local and regional population composition, the impacts on such disadvantaged populations would be beneficial as it is assumed that the majority of the construction workers would be minority and lower income.

As indicated in Table 4.9-2 the greatest adverse impacts on cropland and production, and farm labor would be under Component C, Scenario 2, of the Targeted River Restoration Alternative. Under this scenario 3,492 acres of cropland with an annual production value of over $4 million would be taken out of production. It is estimated that this decrease in cropland could result in a reduction of 35-40 farm workers. This would result in an adverse impact on minority/low income populations since the majority or all of the farm laborers represent this population group.

Table 4.9-2 Summary of Potential Impacts on Socioeconomic Resources and Environmental Justice, Cropland/Farm Labor

Scenario / Component	No Action Alternative	Flood Control Improvement Alternative	Integrated USIBWC Land Management Alternative	Targeted River Restoration Alternative
Scenario 1: With Implementation of Water Conservation Program				
Levee material borrow sites (acres)	0	50	50	50
Conservation easement acreage (from active croplands)	0	0	0	288
Potential cropland conversion (acres)	0	50	50	388
Value of production (annual)	*No change*	*$58,965*	*$58,965*	*$386,965*
Decrease in farm workers	*No change*	*1-2*	*1-2*	*4-6*
Scenario 2: With Direct Water Rights Acquisition				
Levee material borrow sites (acres)	0	50	50	50
Conservation easements (acres from active croplands)	0	0	0	288
Retirement due to water acquisition	0	0	734	3,154
Potential cropland conversion (acres)	0	50	784	3,492
Value of production (annual)	*No change*	*$58,965*	*$899,435*	*$4,003,605*
Decrease in farm workers	*No change*	*1-2*	*7-9*	*35-40*

The next greatest adverse impacts would also be under Component C, Scenario 2, of the Integrated USIBWC Land Management Alternative. The impacts are greatest under this combined component/scenario for both the Integrated USIBWC Land Management Alternative and the Targeted River Restoration Alternative because of the

additional cropland lost through direct water rights acquisition. The least adverse impacts would occur under the Flood Control Improvement Alternative where cropland would be lost only because of borrow sites for levee construction.

Socioeconomics

No additional equipment or personnel would be required if the current operation and maintenance practices were continued. Thus, the No Action Alternative would not result in any additional construction or operation costs. There would be no impact on cropland and production, or on farm labor.

Since there would not be a need for additional workers, there would be no effects on population or employment rates. The No Action Alternative would not result in relocations to or from the area and, consequently, housing and community services would not be impacted. An EIFS analysis was not performed for this alternative because there would not be any associated costs which could result in socioeconomic changes.

Environmental Justice

There would be no change from the current maintenance practices under the No Action Alternative. Therefore, the situation for minority and low-income populations would remain unchanged.

4.9.3 Flood Control Improvement Alternative

Socioeconomics

The Flood Control Improvement Alternative includes 6 miles of new levees, 2.8 miles of floodwalls and 60.1 miles of raised levees. It was assumed that the USIBWC would hire contractors to carry out these activities. Based on the necessary equipment and materials for these tasks, a crew of approximately 42 workers was used for an estimate of construction activity requirements. Construction of 6 miles of new levee including labor, equipment and compaction costs was estimated at $2.3 million. Labor, equipment and soil compaction costs for 55 miles of raised levee were estimated at $15.6 million. Approximately 12 miles of levee will be raised per year over a 5 year period. Construction of a floodwall, including materials (concrete, form wood, steel), labor and equipment was estimated at $739,000. In determining the socioeconomic impact of the proposed flood control improvement action, a total construction cost estimate of $18.7 million was used with the conservative assumption that all construction would be completed within 5 years. Costs during the first year would be $2.3 million for the new levee, $739,000 for the floodwall, and $3.12 million for raising the height of existing, which totals $16.6 million.

As a result of the proposed action, the local population would not change. Housing and community structure would be unaffected since relocations are not expected. With an unemployment rate of 7.8 percent, the 42 workers required for construction could be hired within the community, making relocations unnecessary. Direct and indirect employment in the region of impact would increase by 104, or only 0.13 percent, significantly below the regional positive RTV of 3.79 percent for this variable.

Total sales volume is defined as the total change in local business volume due to the proposed action. The proposed action would result in an increase in direct and indirect annual total sales volume of $12,267,200, or 0.05 percent, significantly below the regional positive RTV of 8.0 percent. The total direct and indirect annual income would increase 0.09 percent, again significantly below the regional positive RTV of 7.99 percent for this variable.

There would be minor adverse impacts on cropland as 50 acres, with an estimated annual production value of $58,965, would be removed from production for the purposes of borrow sites for levee construction material in rural areas.

Environmental Justice

The Flood Control Improvement Alternative would not disproportionately affect low-income or minority populations. An increase in sales volume of 0.78 percent would be contributed to the local economy, providing a positive impact for these populations. The increase in employment and income could also be beneficial. Low-income and minority populations would not be displaced by the proposed alternative. Business sectors that disproportionately employ low-income or minority populations would be positively affected by the implementation of this alternative.

As discussed in Section 3, colonias are dominated by minority and low-income populations. Approximately 24 percent of employed residents of border colonias are construction workers (Border Low Income Housing Coalition 2001). Any rise in employment due to project construction could benefit colonia residents. There would be no adverse impact on minority and low-income populations as a result of the small amount of cropland removed from production.

4.9.4 Integrated USIBWC Land Management Alternative

Socioeconomics

In determining the socioeconomic impact of the Integrated USIBWC Land Management Alternative, a total construction estimate of $19.5 million was used. This includes $18.7 million for flood control improvement (described above) and $768,000 for annual habitat enhancement and vegetation management costs (20-year implementation period). Habitat enhancement includes salt cedar removal and control, cottonwood replacement and regeneration, and modified grazing.

The proposed vegetation management program is expected to span approximately 20 years; however construction of the flood control improvements is assumed to be completed in 5 years. For purposes of this analysis, the initial year of construction and maximum cost of $17.37 million ($16.60 + $0.77) was used for a conservative analysis of effects. USIBWC would implement the vegetation maintenance program with existing staff. An estimated 42 additional workers for construction of flood control improvements would be required.

This alternative would not result in a population change. Therefore, housing and community structure, including public protection, education and medical care, would not

be affected. No relocations would be expected; the estimated 42 workers could be hired locally. The annual impacts from levee construction on business sales volume, employment and income would be the same as under the Flood Control Improvement Alternative.

Potential effects with implementation of a water conservation program (Scenario 1), would be similar to those impacts under the Flood Control Improvement Alternative. A potential adverse effect would occur by direct water acquisition (Scenario 2) as 784 acres, with an estimated annual production value of $899,435, would be removed from production. This cropland conversion would consist of 50 acres of borrow sites for levee material in rural areas, and 734 acres associated with direct water rights acquisition.

Environmental Justice

The Integrated USIBWC Land Management Alternative would not disproportionately affect low-income or minority populations. Though the rise in sale volume, employment and income could benefit low-income and minority populations. Also, a rise in construction employment could benefit colonia residents. No displacements would occur, and the business sectors that disproportionately employ low-income and minority populations could be positively affected.

There could potentially be some adverse effects on low-income and minority population as a result of the implementation and subsequent management operations under this alternative. Under Scenario 2, it is estimated that 7-9 farm labor jobs could be lost because of the removal of cropland from production.

4.9.5 Targeted River Restoration Alternative

Socioeconomics

In determining socioeconomic effects of the Targeted River Restoration Alternative, a total construction cost estimate of $21 million was used. This estimate includes $18.7 million in flood control improvements and $1.1 million for annual habitat improvements and vegetation management (20-year implementation period). Habitat enhancement under this alternative would include salt cedar removal and control, cottonwood planting, meander restoration, and conservation easements. Additional costs would include acquisition of 288 acres of voluntary agricultural easements.

The vegetation management program under consideration is expected to span approximately 20 years; however, construction of the flood control improvements is assumed to be completed in 5 years. For purposes of this analysis, the initial year of construction and maximum cost of $21 million was used for a conservative analysis of effects. The USIBWC would implement the vegetation maintenance program with existing staff. An estimated 42 additional workers for construction of flood control improvements would be required.

The local population is not expected to change as a result of this alternative. Relocations are not expected; therefore housing and community structure would remain unaffected. The annual impacts from levee construction on business sales volume,

employment and income would be the same as under the Flood Control Improvement Alternative and the Integrated USIBWC Land Management Alternative.

Adverse socioeconomic effects could be associated with this alternative under both scenarios evaluated due to potential farmland retirement (Table 4.9-2). With implementation of a water conservation program (Scenario 1), potential cropland conversion would be 388 acres. The estimated loss in annual production value would be $386,965. With direct water rights acquisition, approximately 3,492 acres with an estimated annual production value of $4,003,605 would be removed from production. This retired cropland would consist of 50 acres of borrow sites, 288 acres of voluntary conservation easements, and 3,154 acres associated with direct water rights acquisition. This conversion would represent the most adverse effect of all the alternatives under consideration.

Environmental Justice

The Targeted River Restoration Alternative would not disproportionately affect low-income or minority populations. Though increases in sales volume, employment and income fall below their respective RTVs, any rise could be potentially beneficial. Low-income and minority populations, particularly colonia residents, could benefit from an increase in construction employment. Low-income and minority populations would not be displaced by the proposed alternative. Business sectors that disproportionately employ low-income and minority populations could be positively affected.

There could potentially be adverse effects on low-income and minority population as a result of the implementation and subsequent management operations under this alternative. Under Scenario 2, it is estimated that 35-40 farm labor jobs could be lost as a result of the removal of cropland from production.

4.10 CULTURAL RESOURCES

As defined in Section 106 of the National Historic Preservation Act (NHPA) and in conjunction with NEPA, an adverse effect on a cultural resource could occur due to an action that could 1) physically damage or destroy all or part of the property; 2) isolate the property or alter the character of the property's setting, when that character contributes to the property's qualification for the National Register of Historic Places (NRHP); 3) introduce visual, audible, or atmospheric elements that are out of character with the property or alter its setting; 4) result in neglect of a property leading to its deterioration or destruction; or 5) result in the transfer, lease, or sale of the property without adequate restriction or conditions included to ensure preservation of the property's significant historic features.

Effects to NRHP-eligible archaeological and architectural resources, and traditional cultural properties as a result of the proposed RGCP alternatives may include ground disturbance; increased soil erosion from vegetation removal through burning; reduced maintenance of landscape near architectural resources; and audio or visual intrusions to historic or traditional settings. Ground disturbance and soil erosion may damage or destroy the physical integrity and decrease or destroy research potential of a cultural

resource, and subsequently, alter the NRHP eligibility of the resource. Audio or visual intrusions resulting from the short term construction phase of the RGCP may disturb historic settings associated with architectural resources or disrupt the use of sacred or sensitive traditional cultural properties. The following evaluation criteria were used in the analysis for river management alternatives effects on cultural resources:

- Potential adverse effect on architectural resources;
- Potential adverse effects on traditional cultural properties;
- Potential adverse effects on known archaeological sites; and
- Potential adverse effects on undiscovered cultural resources

4.10.1 Method of Analysis

The areas of potential effect (APE, as defined by Section 106 of the NHPA) were defined for the cultural resource types. The APE for archaeological and architectural resources consisted of the RGCP ROW corridor and any areas outside the ROW designated for ground disturbing activities. The APE for traditional cultural properties was defined as the broader cultural resources study area which was the 2-mile wide corridor along the length of the RGCP.

The cultural resource impact analysis was based on the comparison of known or potential cultural resources locations with locations of environmental measures under consideration along the RGCP. Assumptions listed in Table 4.10-1 were used in the effects analysis.

Table 4.10-1 Assumptions for Cultural Resources Effects Analysis

Measure	Assumptions for Effects Evaluation
Levee rehabilitation	Ground disturbance associated with construction of new levees and floodwall has potential effects. Ground disturbance associated with excavation of materials borrow sites has potential effects. In-place rehabilitation of levees by increase in height has little or no potential effect.
Modify grazing practices	Potential beneficial impact through stabilization of landforms by increasing vegetative cover for soil erosion control. Vegetation treatments, such as burns and mechanical thinning, has a potential effect.
Modified grassland management in floodway	Mowing and planting limited to surface soil preparation and maintenance has little or no potential effects.
Plant woody native vegetation	Planting and/or irrigation limited to surface soil preparation and maintenance has potential effects.
Enhance existing bosques	Removal of invasive plants on floodplain limited to surface disturbance and maintenance has little or no potential effect
Bank shavedowns	Ground disturbance associated with excavation and soil disposal has potential effects.

Measure	Assumptions for Effects Evaluation
Open former meanders	Ground disturbance associated with excavation and heavy equipment use has potential effects. Soil disposal activities may decrease accessibility to cultural resources.
Modify dredging at arroyos	Ground disturbance associated with excavation and heavy equipment has potential effects. Soil disposal activities may decrease accessibility to cultural resources.
Controlled peak flows	Ground disturbance associated with disking and excavation of stream banks has potential effects.
Voluntary conservation easements	Potential beneficial effects through converting cultivated lands to natural grasslands. Removal of salt cedar limited to surface disturbance and maintenance has little or no potential effect.

4.10.2 Summary of Potential Effects

Table 4.10-2 presents a summary of potential effects of river management alternatives under consideration on cultural resources.

Table 4.10-2 Summary of Potential Effects on Cultural Resources

Criteria for Potential Effects	No Action Alternative	Flood Control Improvement Alternative	Integrated USIBWC Land Management Alternative	Targeted River Restoration Alternative
Architectural resources	No effect	No effect	No effect	No effect
Traditional cultural properties	No effect	No effect	No effect	No effect
Known archaeological sites	No effect	No effect	No effect	Two projects (one meander reopening and one arroyo dredging) would be in the general vicinity of a recorded site
Areas with a greater potential for undiscovered cultural resources	No effect	No effect	Two areas with a greater potential for undiscovered sites would be located in the general vicinity of shavedown projects.	The areas with a greater potential for undiscovered sites would be located near arroyo or meander projects.

4.10.3 No Action Alternative

Under this alternative, current operations and maintenance activities would continue. Routine maintenance of three historic dams: the American Diversion Dam (listed on the New Mexico SRCP), the Percha Diversion Dam (NRHP-listed) and the Leasburg Dam (listed on the New Mexico SRCP) will occur. Engineering evaluations for the erosion protection of the Hatch and Rincon Siphons and the Picacho Flume (all

historic resources) have been completed by the USIBWC and will be implemented to protect these resources. Continued maintenance would also include other irrigation structures and historic bridges. Operations and maintenance of historic architectural resources will continue to follow existing guidelines and regulations.

The No Action Alternative will not effect or adversely affect any architectural resources, traditional cultural properties or archaeological resources.

4.10.4 Flood Control Improvement Alternative

Levee system rehabilitation has the potential for adverse effects on cultural resources due to excavation at the levee or at material borrow locations. Rehabilitation would entail construction of a 2.8 mile floodwall and 6 miles of new levees, and rehabilitation of existing levees by increasing their height and footprint. A low potential for effects on undiscovered sites was assumed for in-place levee rehabilitation. No traditional cultural properties or architectural resources have been identified for project areas under consideration and, thus, no adverse effects are anticipated on these cultural resources.

Floodwall construction has a low potential for adverse effects on undiscovered sites, as it would be constructed in the urban area of Canutillo (river mile 13), in extensively disturbed terrain along an existing railroad berm. None of the 27 areas identified as having potential for undiscovered cultural sites are located in the Canutillo area.

Construction would be primarily in the El Paso RMU (5.4 river miles), to a lesser extent in the Lower Rincon (0.6 river miles). In El Paso RMU, known archaeological sites were identified for river mile 5, and areas with a potential for undiscovered cultural sites at miles 5, 7 in the east bank, and 14, 15 and 16 in the west bank. These areas have existing levees and, consequently, no adverse effects are expected. In the Lower Rincon RMU, new levee construction would not be conducted in areas where a potential for undiscovered cultural resources has been identified.

Modified grazing practices would have a beneficial impact to subsurface archaeological sites by stabilizing landforms through increasing vegetative cover for soil erosion control. However, vegetation treatments, such as burns and mechanical thinning, will adversely effect surface archaeological sites by damaging or destroying artifacts and generate carbon that has the potential to interfere with carbon dating of archaeological sites.

4.10.5 Integrated USIBWC Land Management

In addition to the levee system rehabilitation and the modified leases previously discussed, three measures associated with this alternative were identified as potentially having effects on cultural resources: modified grassland management, bosque enhancement, and shavedowns for stream bank reconfiguration. No traditional cultural properties or architectural resources have been identified for project areas under consideration and, thus, no adverse effects are anticipated on these cultural resources.

Mowing and planting native grass in the floodways and levee slopes would have little or no effect on cultural resources. These activities involve minimal surface disturbance and any cultural resources on the floodplains are expected to be subsurface.

Planting of native vegetation and removal of invasive plants in the bosques located on the floodplains would have little or no effect on cultural resources. This activity would involve minimal surface disturbance and any cultural resources on the floodplains are expected to be subsurface.

Table 4.10-3 shows the river mile of shavedown sites relative to the general location of known archaeological sites and areas with a greater potential for undiscovered cultural resources. Two shavedown projects listed in Table 4.10-3 are within the same river mile as recorded archaeological site, but no adverse effect from shavedowns are anticipated. Both sites are either located more than ½ mile from the shavedown projects. Two areas with a greater potential for undiscovered cultural resources are located in the general vicinity of shavedown projects 83B and 94B. If undiscovered cultural resources occur, some are likely to be considered potentially eligible for the NRHP. Implementation of the shavedown projects may have an adverse effect on NRHP-eligible archaeological resources.

Table 4.10-3 Cultural Resources Locations Relative to Point Projects for the Integrated USIBWC Land Management Alternative

River Management Unit	Mile Range	Archaeological Sites Along the RGCP	Areas with a Greater Potential for Undiscovered Sites	Stream Bank Shavedowns by River Mile
El Paso	0-21	1 location	5 locations	
Lower Mesilla	21-40		4 locations	
Las Cruces	40-51		1 location	
Upper Mesilla	51-63	2 locations	3 locations	
Seldon Canyon	63-72	4 locations	4 locations	
Lower Rincon	72-90	2 locations	6 locations	76, 83
Upper Rincon	105-90	3 locations	4 locations	92, 94, 98, 101, 102, 103, 104

4.10.6 Targeted River Restoration

In addition to the levee system rehabilitation, modified leases, modified grassland management, native vegetation planting/bosque enhancement previously discussed, three measures associated with this alternative were identified as potentially having effects on cultural resources: controlled peak flows, reopening of meanders, and modified dredging of arroyos. No traditional cultural properties or architectural resources have been identified for project areas under consideration and, thus, no adverse effects are anticipated on these cultural resources.

Disking and excavation of stream banks has a potential for adverse effects to archaeological sites.

Excavation of meanders has a low potential for adverse effects since former active channels have a low probability of preserving materials dating before the start of canalization. Spoil disposal locations and practices could result in the burial of unrecorded archaeological sites, protecting them, but also making them inaccessible to researchers. Heavy equipment could also impact surface archaeological remains, damaging or destroying their physical integrity, degrading their research potential and subsequently, their NRHP eligibility.

Table 4.10-4 shows the relative location of meander sites relative to archaeological sites and areas with a higher potential for undiscovered cultural resources. One listed project was identified in the general vicinity of a recorded archaeological site. An area with a higher potential for undiscovered sites was also located near a menader project. If undiscovered cultural resources occur, some are likely to be considered potentially eligible for the NRHP. Excavation of meanders may have an adverse effect on NRHP-eligible archaeological resources.

Spoil disposal locations and practices could result in the burial of unrecorded archaeological sites, protecting them, but also making them inaccessible to researchers. Heavy equipment could also impact surface archaeological remains damaging or destroying their physical integrity, degrading their research potential and subsequently, their NRHP eligibility.

Table 4.10-4 shows arroyo dredging locations relative to the general location of known archaeological sites and areas with a greater potential for undiscovered cultural resources. One listed arroyo project is identified with the same river mile as a recorded archaeological site, but in the opposite bank, so no adverse effect is anticipated. Four areas with a greater potential for undiscovered sites are located in the same river mile as arroyo projects. Two of those areas are in the general vicinity of arroyo projects. If undiscovered cultural resources occur, some are likely to be considered potentially eligible for the NRHP. Implementation of arroyo dredging might have an adverse effect on NRHP-eligible archaeological resources.

Table 4.10-4 Cultural Resources Locations Relative to Point Projects for the Targeted River Restoration Alternative

River Management Unit	Mile Range	Archaeological Sites Along the RGCP	Areas With a Greater Potential for Undiscovered Sites	Reopening of Meanders (river mile)	Modified Arroyo Dredging (river mile)
El Paso	0-21	1 location	5 locations		
Lower Mesilla	21-40		4 locations		
Las Cruces	40-51		1 location		
Upper Mesilla	51-63	2 locations	3 locations	54	
Seldon Canyon	63-72	4 locations	4 locations		
Lower Rincon	72-90	2 locations	6 locations		76, 78, 83, 85
Upper Rincon	105-90	3 locations	4 locations	92, 95, 97, 102, 105	94, 97, 98, 99, 101, 102, 103, 104

Potential beneficial impacts may occur by the conversion of cultivated lands to natural grasslands. Disturbance of archaeological sites resulting from continuous plowing would cease with this conversion. Planting of native vegetation and removal of invasive plants in the bosques located on the floodplains would have little or no effect on cultural resources. This activity would involve minimal surface disturbance and any cultural resources on the floodplains are expected to be subsurface. However, reduced maintenance along historic irrigation drains or canals may adversely affect these resources through bioturbation resulting in a decrease in physical integrity.

4.11 AIR QUALITY

The evaluation criteria considered for measuring effects to air quality were based on whether the net change in pollutant emissions from implementation of environmental measures:

- Caused or contributed to a violation of any national, state, or local ambient air quality standard;
- Increased the frequency or severity of a violation of any ambient air quality standard;
- Delayed the attainment of any standard or other milestone contained in the New Mexico or Texas implementation plan; or
- Increased a nonattainment or maintenance area's emissions inventory by ten percent or more for individual nonattainment pollutants; or exceeded *de minimis* threshold levels established in 40 CFR 93.153(b) for individual nonattainment pollutants.

4.11.1 Method of Analysis

Air emissions were calculated for the entire RGCP on the basis of annual releases. Emissions from implementation of the environmental measures would extend over several years; therefore, the emissions were allocated equally by year. As a conservative assumption for the emission calculations, measures were assumed to take place concurrently along the entire RGCP even though gradual implementation throughout a 20-year horizon is anticipated. Calculations were based on assumptions listed in Table 4.11-1 by individual measures.

Emissions for the various measures were calculated on a per-acre, per-mile or per-cubic yard basis, as indicated in Table 4.11-2. Unit emissions for the five priority pollutants were then applied according to specific input data assigned to each of the alternatives under consideration. Unit emissions were calculated based on the amount of soil disturbed, estimated number of hours of equipment operation, and on man-hour labor and equipment production estimates. Estimates followed common construction practices and methodologies (Means 2002), and emission factors reported by USEPA (USEPA 2000).

Table 4.11-1 Assumptions and Basis for Calculation of Air Emissions

Type of Measure	General Assumptions	Basis for Calculation
Current O&M Practices		
Sediment removal from the main channel and arroyos	Dredging is conducted infrequently over a several year period and limited to selected reaches; calculations are based on annual removal.	Up to 251, 000 cy and 47,500 cy removed from the channel and arroyos, respectively
Riprap placement along the channel	Conducted infrequently at limited reaches. Assume regularly along 20% of stream banks.	20.3 miles per year.
Mowing of floodway	Conducted during the late spring over a 3 month period using mechanical mowers.	4,657 acres/year.
Maintenance of levees and levee/access roads	Entire levee system per year plus 10 miles/year both for levee gravel roads and for access roads.	131 miles of levee and 20 of roads maintained per year.
Levee System Rehabilitation		
New levees	Entire construction in 1 year; 7 acres/mile of levee for material borrow sites; excavated to a depth of 3 ft. (36,000 cy/mile).	6 miles of new levee
Levee height increase	5 year rehabilitation program (60.1 miles), 4 acres/mile for material borrow sites (21,000 cy/mile).	12 miles of levee rehabilitation per year
Floodwall construction	2.8 miles of floodwall all built in 1 year; 5.5 acres of disturbed area; 645 cy of concrete per mile	2.8 miles in one year
Construction in non-attainment areas	*El Paso County*: a subset of emissions above baseline that apply to El Paso RMU for levee rehabilitation was used. No environmental measures such as planting, shavedowns, or controlled are under consideration for that reach of the RGCP.	36.8% of RGCP emissions for potential levee rehabilitation (26.5 out of 72.1 miles).
	Las Cruces (Doña Ana County): a subset of emissions above baseline that apply to Las Cruces RMU was used. Applicable values are levee rehabilitation (18.1 out of 72.1 miles along the RGCP), as well as environmental measures under the Integrated USIBWC Land Management Alternative (Las Cruces RMU represents 11.2 miles of the 105.4 mile corridor).	25.1% of emissions for levee rehabilitation, and 10.6% of emissions for environmental measures.
Environmental Measures		
Modified grazing and management of native grasslands	Soil preparation and associated emissions for exposed soil and mowing/tilling equipment on a per-acre basis assuming a 10% implementation per year. Includes prescribed burning emissions (based on an average of 2.6 ton/acre of grass biomass).	Emissions for 334 ac/yr of prescribed burns.
Tree planting/bosque enhancement sites, and controlled overbank flows	Soil preparation by mowing/tilling, with dust and equipment emissions on a per-acre basis. It assumes a 10% implementation per year, with prescribed burning emissions from 25% selective salt cedar removal. Emissions based on an average of 15 ton/acre of biomass removal for burning reported for chaparral vegetation).	Emissions for up to 74 acres per year (10% of 223 acres of planting sites and 516 acres of induced overbank flows).
Bank shavedowns and open former meanders	Excavation to an average depth of 2 ft. and soil preparation. Emissions calculated on a per-acre basis from soil exposure and transfer, and associated equipment. An assumed 5-year implementation includes prescribed burning from 25% selective salt cedar removal.	Emissions for up to 55 acres per year (20% of 127 acres of shavedowns and 300 acres of open meanders).
Sediment disposal from arroyo dredging	Excavation of 6.8 acres to an average depth of 4 feet with sediment placement on the ROW to a depth of 2 ft.	Emissions from up to 14 acres of exposed soils.

Table 4.11-2 Calculated Unit Air Emissions by Measure

Measure	Input Data	Unit Emissions per Measure (tons/year)				
		SOx	NOx	CO	VOC	PM_{10}
Sediment removal from main channel	10^6 cubic yards	9.97	91.49	38.51	6.93	5.78
Sediment removal from arroyos	10^6 cubic yards	9.81	90.05	37.90	6.82	5.69
Mowing of floodways	1,000 acres	0.37	3.36	0.92	0.39	0.37
Placement of riprap	miles	0.02	0.21	0.06	0.03	0.02
Mowing/brush cutting on levee slopes	1,000 acres	1.84	16.91	4.64	1.99	1.59
Levee road grading and resurfacing	miles	0.43	3.94	1.66	0.29	4.49
Grading access roads	miles	0.43	3.94	1.66	0.29	2.37
Construction of new levees	miles	0.91	8.44	3.52	0.67	11.09
Increase levee height	miles	0.55	5.05	2.10	0.40	5.61
Construction of new floodwalls	miles	0.09	0.88	1.05	0.09	0.30
Excavation (bank shavedowns)	acres	0.081	0.754	0.317	0.060	1.488
Exposed soils (soil preparation)	1,000 acres	0.00	0.00	0.00	0.00	1.86
Prescribed burning -grasslands	acres	0.001	0.007	0.190	0.018	0.026
Prescribed burning - salt cedar control	acres	0.005	0.044	1.230	0.115	0.169
Reopen meanders within ROW	acres	0.08	0.75	0.32	0.06	1.49

4.11.2 Summary of Potential Effects

Table 4.11-3 summarizes air quality effects of the proposed action, alternative actions, and the No Action alternative.

Table 4.11-3 Summary of Air Quality Effects

No Action Alternative	Flood Control Improvement Alternative	Integrated USIBWC Land Management Alternative	Targeted River Restoration Alternative
Criteria pollutant levels for criteria pollutants range from 0.03% to 0.56% for AQCR	Criteria pollutant increases in AQCR range from 0.05 to 0.93 percent and are not regionally significant.	Criteria pollutant increases in AQCR range from 0.01 to 1.25 percent and are not regionally significant.	Criteria pollutant increases in AQCR range from 0.12 to 1.62 percent and are not regionally significant

4.11.3 No Action Alternative

Emissions generating activities for the No Action Alternative would be the same as the current ongoing activities. Therefore, the emissions calculated as a result of the current activities (see Table 3.11.6) would apply to the alternative. As mentioned in Subsection 3.11.3, the emissions data for Sierra, Doña Ana, and El Paso counties are used for analysis purposes because the activity associated with the alternative would be localized in the narrow area along the river, and emissions from the activities would not be likely to affect the more distant AQCR counties in New Mexico and Texas.

Table 4.11-4 presents the baseline emissions data for the three counties and the No Action Alternative, and compares the alternative with the baseline condition.

Table 4.11-4 Estimated Annual Emissions for No Action Alternative

Criteria Air Pollutant	Emissions in Tons per Year (tons/year)				
	CO	VOC	NOx	Sox	PM_{10}
Totals for 3 counties (USEPA 2003)	244,417	34,593	40	3,315	79,039
Estimated annual emissions from No Action Alternative	68.1	13.6	170.2	18.6	96.6
No Action Alternative emissions as percent of emissions for 3 Counties	0.03%	0.04%	0.42%	0.56%	0.12%

Note:VOC is not a criteria air pollutant. However, VOC is reported because, as an ozone precursor, it is a controlled pollutant.

Review of the data in Table 4.11-4 indicates that the greatest volume of air emissions No Action Alternative activities would be NOx (170.23 tons), which equates to 0.42 percent of the NOx emissions within the three county area. The effects would be temporary, fall off rapidly with distance from the routine O&M activity construction, and would not result in any long-term effects.

Ongoing activities currently being conducted are exempt from the Final General Conformity Rule so long as there is no increase in emissions equal to or greater than above the *de minimis* levels as the result of the Federal action. The No Action Alternative would be a continuation of the current USIBWC activities and, therefore, emissions would be the same as the baseline. The emissions from these activities would not increase emissions above *de minimis* levels. Therefore, the alternative would be exempt from further conformity requirements specified by the USEPA Final General Conformity Rule and a conformity determination would not be required.

4.11.4 Flood Control Improvement Alternative

In addition to the activities anticipated under the No Action Alternative, actions under this alternative generating emissions would include constructing new levees and floodwalls, increasing height of levees, and new floodwalls. Fugitive dust from ground disturbing activities and combustive emissions from equipment operation would be generated as a result of the activities.

Fugitive Dust

Fugitive dust would be generated from activities associated with soil disturbance and from equipment and vehicular traffic moving over the disturbed site. These emissions would be greatest during the initial site preparation activities and would vary from day to day depending on the construction phase, level of activity, and prevailing weather conditions.

The quantity of uncontrolled fugitive dust emissions from a construction site is proportional to the area of land being worked and the level of construction activity. The USEPA has estimated that uncontrolled fugitive dust emissions from ground-disturbing activities would be emitted at a rate of 80 lbs of TSP per acre per day of disturbance

(USEPA 1996). In a USEPA study of air sampling data at a distance of 50 meters downwind from construction activities, PM_{10} emissions from various open dust sources were determined based on the ratio of PM_{10} to TSP sampling data. The average PM_{10} to TSP ratios for top soil removal, aggregate hauling, and cut and fill operations is reported as 0.27, 0.23, and 0.22, respectively (USEPA 1988). Using 0.24 as the average ratio for purposes of analysis, the emission factor for PM_{10} dust emissions becomes 19.2 lbs per acre per day of disturbance.

Equipment Emissions

Emissions generated from mowing activities on the levee slopes and within the floodways were calculated by using the emission rate from grain harvesting equipment. Equipment used for the analysis includes rotary disc mowers pulled behind tractors in 20-foot swaths at a speed of 11 feet per second. Mowing is done annually between May and June. The emission factor used in the calculation for PM_{10} dust emissions is 0.027 lbs per hour of tractor operations (USEPA 1996).

The USEPA also assumes that 230 working days are available per year for construction (accounting for weekends, weather, and holidays), and that only half of these working days would result in uncontrolled fugitive dust emissions at the emitted rate described above (USEPA 1996). The emissions presented in Table 4.11-4 include the estimated annual PM_{10} and $PM_{2.5}$ emissions associated with the project activities. These emissions would produce slightly elevated short-term PM_{10} and $PM_{2.5}$ ambient air concentrations. The USEPA estimates that the effects of fugitive dust from construction activities would be reduced significantly with an effective watering program. Watering the disturbed area of the construction site twice per day with approximately 3,500 gallons per acre per day would reduce TSP emissions as much as 50 percent (USEPA 1996).

Specific information describing the types of construction equipment required for a specific task, the hours the equipment is operated, and the operating conditions vary widely from project to project. Emissions were calculated using established cost estimating methodologies for construction and experience with similar types of construction projects (Means 2002). Combustive emissions from construction equipment exhausts were estimated by using USEPA approved emissions factors for heavy-duty diesel-powered construction equipment (USEPA 1985). The emissions presented in Table 4.11-5 include the estimated annual emissions from equipment exhaust associated with the proposed activities. Table 4.11-5 lists the annual emissions and the annual percent of change when compared to the baseline for the alternative action.

The emissions would produce slightly elevated air pollutant concentrations. Review of the data in Table 4.11-6 indicates that the greatest volume of emissions would be NOx (283.9 tons), which equates to 0.71 percent of the NOx emissions within the three county area. However, the effects would be temporary, fall off rapidly with distance from the proposed construction sites, and would not result in any long-term effects.

Table 4.11-5 Estimated Annual Emissions for Flood Control Improvement Alternative

Criteria Air Pollutant	Emission (tons/year)				
	CO	VOC	NOx	SOx	PM_{10}
Totals for 3 counties (USEPA 2003)	224,417	35,593	40,012	3,315	79,039
Estimated emissions for Flood Control Improvement Alternative	117.4	22.6	283.9	30.9	231.3
Alternative emissions as percent of emissions for 3 Counties	0.05%	0.06%	0.71%	0.93%	0.29%

Approximately 37 percent of the environmental measure activities would occur in El Paso County and about 25 percent in Doña Ana County. As shown in Table 3.11-4, part of El Paso County is designated nonattainment for CO and PM_{10}, classification moderate and nonattainment for Ozone, classification serious. Similarly, part of Doña Ana County is also nonattainment for Ozone and PM_{10}, classification marginal and moderate, respectively. Therefore, to show that the emissions presented in Table 4.11-7 are not above *de minimis* levels for nonattainment areas, the values are reduced by the percentage of the work that would be conducted in the respective counties. Therefore, the emissions shown in Table 4.12-6 are reduced accordingly and the values shown in Table 4.12-7 would be more representative of the actual emissions generated from construction activities in El Paso and Doña Ana Counties.

Table 4.11-6 Estimated Annual Emissions for El Paso and Doña Ana Counties

Calculation	Emission (tons/year)				
	CO	VOC	NOx	SOx	PM_{10}
El Paso County					
Flood Control Improvement Alternative emissions	117.4	22.6	283.9	30.9	231.3
Less No Action Alternative	68.1	13.6	170.2	18.6	96.6
Net emissions	49.3	9.0	113.7	12.3	134.7
37% applicable to El Paso	**18.14**	**3.32**	**41.83**	**4.53**	**49.56**
Doña Ana County					
Flood Control Improvement Alternative emissions	117.4	22.6	283.9	30.9	231.3
Less No Action Alternative	68.1	13.6	170.2	18.6	96.6
Net emissions	49.3	9.0	113.7	12.3	134.7
25% applicable to Doña Ana	**12.38**	**2.26**	**28.53**	**3.09**	**33.80**

Emissions generated as a result of this alternative would fall below the 10 percent level (see Table 4.11-5) that would be considered regionally significant by the USEPA. Additionally, the emissions would not exceed *de minimis* threshold levels for criteria pollutants. Since the net change in potential emissions associated with alternative action activities meet both regional significance and *de minimis* criteria requirements, it is concluded that this Federal action alternative is exempt from further conformity requirements specified by the USEPA Final General Conformity Rule.

4.11.5 Integrated USIBWC Land Management Alternative

The methodologies used to calculate emissions for the Flood Control Improvement Alternative were used to estimate the emissions for the Integrated USIBWC Land Management Alternative. Table 4.11-7 lists the annual emissions for the alternative and compares them to the emissions for the three county area.

Table 4.11-7 Estimated Annual Emissions for Integrated USIBWC Land Management Alternative

Criteria Air Pollutant	Emission (tons/year)				
	CO	VOC	NOx	SOx	PM_{10}
Totals for 3 counties (USEPA 2003)	244,417	34,593	40,012	3,315	79,039
Estimated emissions for the Integrated USIBWC Land Management Alternative	237.0	37.7	382.5	41.6	431.5
Alternative emissions as percent of emissions for 3 Counties	0.01%	0.11%	0.96%	1.25%	0.55%

The emissions would produce slightly elevated air pollutant concentrations. Review of the data in Table 4.11-7 indicates that the greatest volume of emissions would be NOx (382.5 tons), which equates to 0.96 percent of the NOx emissions within the three county area. However, the effects would be temporary, fall off rapidly with distance from the proposed construction sites, and would not result in any long-term effects.

Approximately 11 percent of the environmental measure activities for the Integrated USIBWC Land Management Alternative would occur in the Las Cruces area of Doña Ana County. As shown in Table 3.11-4, part of Doña Ana County is nonattainment for Ozone and PM_{10}, classification marginal and moderate, respectively. Therefore, to show that the emissions presented in Table 4.11-7 are not above *de minimis* levels for nonattainment areas, the values are reduced by the percentage of the work that would be conducted in the respective counties. Therefore, the emissions shown Table 4.11-7 are reduced accordingly and the values shown in Table 4.11-8 would be more representative of the actual emissions generated from construction activities near Las Cruces.

Table 4.11-8 Estimated Annual Emissions for Las Cruces Area

Doña Ana County	Emission (tons/year)				
	CO	VOC	NOx	SOx	PM_{10}
Basis for Levee Rehabilitation Calculation					
Integrated Land Management Alternative	237.0	37.7	382.5	41.6	431.5
Less Flood Control Improvement Alternative emissions	117.4	22.6	283.9	30.9	231.3
Net Emissions	119.6	15.1	98.6	10.7	200.3
10.6% applicable to Las Cruces	**12.68**	**1.6**	**10.45**	**1.13**	**21.23**

Emissions generated as a result of this alternative would fall below the 10 percent level (see Table 4.11-7) that would be considered regionally significant by the USEPA. Additionally, the emissions would not exceed *de minimis* threshold levels for criteria pollutants. Since the net change in potential emissions associated with alternative action activities meet both regional significance and *de minimis* criteria requirements, it is concluded that this Federal action alternative is exempt from further conformity requirements specified by the USEPA Final General Conformity Rule.

4.11.6 Targeted River Restoration Alternative

In addition to the activities anticipated under the Flood Control Improvement Alternatives, actions under this alternative generating emissions would include reopening meanders, removing riprap near arroyos, creating or expanding wetlands, and preparing land for controlled water releases for overbank flooding. The methodologies used to calculate emissions for the Flood Control Improvement Alternative were used to estimate the emissions for the Targeted River Restoration Alternative. Table 4.11-9 lists the annual emissions for the alternative and compares them to the emissions for the three county area.

Table 4.11-9 Estimated Annual Emissions for Targeted River Restoration Alternative

	Emission (tons/year)				
Criteria Air Pollutant	**CO**	**VOC**	**NOx**	**SOx**	**PM_{10}**
Totals for 3 counties (USEPA 2003)	244,417	34,593	40,012	3,315	79,039
Estimated emissions for Targeted River Restoration Alternative	283.5	46.5	493.3	53.6	650.3
Alternative emissions as percent of emissions for 3 Counties	0.12%	0.13%	1.23%	1.62%	0.82%

The emissions would produce slightly elevated air pollutant concentrations. Review of the data in Table 4.11-9 indicates that the greatest volume of emissions would be NOx (493.3 tons) and PM_{10} (650.3 tons), which equates to 1.23 percent and 0.82 percent of the NOx and PM_{10} emissions within the three county area, respectively. However, the effects would be temporary, fall off rapidly with distance from the proposed construction sites, and would not result in any long-term effects.

Similar to the Integrated USIBWC Land Management Alternative, approximately 11 percent of the environmental measure activities for the Targeted River Restoration Alternative would occur in the Las Cruces area of Doña Ana County. As shown in Table 3.11-4, part of Doña Ana County is nonattainment for Ozone and PM_{10}, classification marginal and moderate, respectively. Therefore, to show that the emissions presented in Table 4.11-9 are not above *de minimis* levels for nonattainment areas, the values are reduced by the percentage of the work that would be conducted in the respective counties. Therefore, the emissions shown Table 4.11-9 are reduced accordingly and the values shown in Table 4.11-10 would be more representative of the actual emissions generated from construction activities in Doña Ana County.

Table 4.11-10 Estimated Annual Emissions for Las Cruces Area

Doña Ana County	Emission (tons/year)				
	CO	VOC	NOx	SOx	PM_{10}
Basis for Levee Rehabilitation Calculation					
Targeted River Restoration Alternative emissions	283.5	46.5	493.3	53.6	650.3
Less Flood Control Alternative and No Action Alternative emissions	117.4	22.6	283.9	30.9	231.3
Net emissions	166.1	23.9	209.4	22.7	419
10.6% applicable to Las Cruces	17.6	2.5	22.2	2.4	44.4

Emissions generated as a result of this alternative would fall below the 10 percent level (see Table 4.11-9) that would be considered regionally significant by the USEPA. Additionally, the emissions would not exceed *de minimis* threshold levels for criteria pollutants. Since the net change in potential emissions associated with alternative action activities meet both regional significance and *de minimis* criteria requirements, it is concluded that this Federal action alternative is exempt from further conformity requirements specified by the USEPA Final General Conformity Rule.

4.12 NOISE

The evaluation criteria considered for measuring effects from noise were based on the following:

- The degree to which noise levels generated by environmental measures would be higher than the ambient noise levels;
- The degree to which there is annoyance and/or activity interference; and
- The proximity of noise-sensitive receptors to the noise source.

4.12.1 Method of Analysis

Estimates of noise generated from heavy construction equipment were calculated for the environmental measures based on the type of heavy equipment used and the duration of the construction activity. Predicted noise levels for each type of equipment anticipated to be used for the environmental measures are presented in Table 4.12-1. The noise levels in Table 4.12-1 are probably conservative because additional attenuation would be expected because of atmospheric absorption and the effects of topographic or other features such as hills and buildings that could physically block the transmission of some noise waves. Under most conditions, reflected sound would reduce the attenuation due to distance. In these cases, doubling the distance would result in a decrease of 4 to 5 dBA (American Industrial Hygiene Association, 1986). Calculations were based on assumptions listed in Table 4.12-1 by individual measures.

Assuming that noise from the construction equipment radiates equally in all directions, the sound intensity would diminish inversely as the square of the distance from the source. Therefore, in a free field (no reflections of sound), the sound pressure

level decreases 6 dBA with each doubling of the distance from the source. Table 4.12-1 shows the anticipated sound pressure levels at a distance of 50 feet for miscellaneous heavy equipment.

Table 4.12-1 Heavy Equipment Noise Levels at 50 Feet

Equipment Type	Estimated number in use at any time	Generated Noise Levels in dBA (CERL, 1978)
Bulldozer	1	88
Backhoe (rubber tire)	1	80
Front Loader (rubber tire)	1	80
Concrete Truck	1	75
Concrete Finisher	1	80
Crane	1	75
Asphalt Spreader	1	80
Roller	1	80
Flat Bed Truck (18 wheel)	1	75
Scraper	1	89
Trenching Machine	1	85

4.12.2 Summary of Potential Effects

Table 4.12-2 summarizes noise effects of the No Action alternative and action alternatives.

Table 4.12-2 Summary of Noise Effects

No Action Alternative	Flood Control Improvement Alternative	Integrated USIBWC Land Management Alternative	Targeted River Restoration Alternative
75 to 89 dBA at 50 feet from the source	Similar to the No Action Alternative	Similar to the No Action Alternative	Similar to the No Action Alternative

4.12.3 No Action Alternative

The existing maintenance and operation activities would continue to occur. The primary source of noise from these activities would be generated by equipment and vehicles used to excavate the channel, remove sediment, mow levees and sediment control dams, and grade levee roads. Noise from these activities would be intermittent and short-term in duration. Typical noise levels generated by these activities range from 75 to 89 dBA at 50 feet from the source. Sensitive receptors in the vicinity of these short-term activities would include persons near the project site in rural areas and residential districts in the urban areas of Las Cruces and El Paso.

For the purposes of this assessment, it is estimated the shortest distance between an equipment noise source and a receptor in a rural area would be a person(s) 100 feet off-site. Given the rural nature and low population density of the area, it is unlikely a person

other than a construction worker would be within 100 feet of the site boundary during project activities. However, if a person were within this distance, the person could be exposed to noise as high as 69 to 83 dBA (see Table 4.12-1). Sixty-one percent of the person(s) exposed to noise of 83 dBA could be annoyed. As stated in Subsection 3.12.3, DNL 75 dBA during the noise event indicates there is good probability for frequent speech disruption, producing ratings of "barely acceptable" for intelligibility of spoken material. Increasing the level of noise to 80 dB reduces the intelligibility to zero, even if the people speak in loud voices. The potential for hearing loss involves direct exposure on a regular, continuing, long-term basis to DNL levels above 75 dBA. Hearing loss projections are based on an average daily outdoor exposure of 16 hours over a 40-year period. It is anticipated the construction activities would occur between 7:30 a.m. and 4:00 p.m., five days per week for the duration of the project. Individuals would not be exposed for the entire noise producing period. Under this condition, persons would not be exposed to long-term and regular noise above 75 dBA. Therefore, nearby persons should not experience loss of hearing.

As with the rural area, it is estimated the shortest distance between an equipment noise source and a receptor in an urban setting would be a person(s) or a structure 100 feet from the source. Due to the potential for reflected sound in an urban area, it is estimated sound would attenuate 4 to 5 dBA as the distance doubles. Therefore, a person in an urban area conservatively could be exposed to noise as high as 71 to 85 dBA, or about 2 dBA greater than the rural area noise. An increase of 3 dBA is just perceptible to the human ear (Bies and Hanson, 1988). The difference in noise in the two settings likely would be imperceptible and the discussion and analysis in the pervious paragraph for a rural area applies to the noise condition in an urban setting. Interior noise levels would be reduced from the 71 to 85 dBA level by approximately 18 to 27 dBA due to the noise level reduction properties of the building's construction materials (U.S. Department of Transportation, 1992).

4.12.4 Flood Control Improvement Alternative

In addition to the activities anticipated under the No Action Alternative, actions under this alternative requiring equipment operation would include constructing new levees and floodwalls and increasing height of levees. Although the structures and activities that would be constructed and accomplished under this alternative would be different from the No Action Alternative, the equipment that would be used and the distance to a receptor would be the same. Therefore, the analysis and conclusions for the No Action Alternative apply to the alternative.

4.12.5 Integrated USIBWC Land Management Alternative

The noise generating activities for this alternative would be the same as the Flood Control Improvement Alternative. Therefore, the analysis and conclusions for the Flood Control Improvement Alternative apply to this alternative.

4.12.6 Targeted River Restoration Alternative

In addition to the activities anticipated under the Flood Control Improvement Alternatives, actions requiring equipment operation would include reopening meanders, removing riprap near arroyos, creating or expanding wetlands, and preparing land for controlled water releases for overbank flooding. Although the structures and activities that would be constructed and accomplished under this alternative would be different than the No Action Alternative, the equipment that would be used and the distance to a receptor would be the same. Therefore, the analysis and conclusions for the No Action Alternative apply to this alternative.

4.13 TRANSPORTATION

The evaluation criteria considered for measuring effects to transportation were based on whether implementation of environmental measures would:

- Cause an increase in traffic that is substantial in relation to the existing traffic load and capacity of the street system;
- Adversely affect a roadway's existing LOS, such that it would not meet agency standards; or
- Adversely affect roadway condition, such as the development of potholes or cracking.

4.13.1 Method of Analysis

The following methodology was used in evaluating effects on transportation:

- Expected routes were identified on road maps.
- Existing (1997) average daily traffic levels, percentage of truck traffic, and roadway speeds were obtained.
- The number of construction workers and truck trips required for project construction for each alternative were estimated.
- The project construction period of each alternative was estimated.
- Total expected average daily traffic levels were calculated, considering daily truck trips and construction worker trips plus existing levels to determine expected traffic levels during project construction.
- Calculated project construction average daily traffic levels were compared to existing average daily traffic levels to determine if project construction traffic would result in a substantial increase in existing traffic levels.
- LOS associated with average daily traffic levels for existing and project construction conditions were compared to determine potential changes during project construction.

Table Assumptions for Calculating Effects on Transportation

For this analysis, the following assumptions were made:

- A construction workday is considered to last 10 hours, from 7:00 a.m. to 5:00 p.m.
- A month was considered to be 22 workdays.
- Work force for the project area would likely come from construction workers residing and commuting from El Paso and Doña Ana Counties

4.13.2 Summary of Potential Effects

Table 4.13-1 summarizes transportation effects from the No Action Alternative.

Table 4.13-1 Summary of Transportation Effects

No Action Alternative	Flood Control Improvement Alternative	Integrated USIBWC Land Management Alternative	Targeted River Restoration Alternative
No increase in traffic or affect existing Level of Service (LOS)	The LOS of all listed roadways would not change from existing conditions.	The LOS of all listed roadways would not change from existing conditions	The LOS of all listed roadways would not change from existing conditions

4.13.3 No Action Alternative

No additional construction equipment or vehicles would be required if the current operation and maintenance practices were continued. None of the proposed construction projects would be constructed. The No Action Alternative would not result in any increases in traffic or adversely affect a roadway's existing LOS. Traffic levels on interstate, state, and local roadways would be expected to increase as a result of population growth. This may result in a corresponding increase in traffic congestion and more wear and tear on the roadways. If the LOS on Texas roadways falls below C, and the LOS on New Mexico roadways falls below B, this impact would be considered significant.

4.13.4 Flood Control Improvement Alternative

Under the Flood Control Improvement Alternative, construction would include six miles of new levees, three miles for additional floodwalls, and 60 miles for raising of existing levees. All construction activities would occur within the existing USIBWC ROW and within agricultural and government lands. Transportation of construction equipment and the use of personnel vehicles would mainly occur within the levee ROW and along the levee road system within the floodway.

Heavy construction equipment (dump trucks, front-end loaders, graders) would initially be driven to the construction site from larger metropolitan cities like El Paso or Las Cruces using the roadways presented in Table 3.13-1. Implementation of this alternative would be comparable to the No Action Alternative since USIBWC currently provides similar construction and maintenance projects along the Rio Grande.

Construction activities associated with levee rehabilitation are presented in Table 4.13-2. The majority, about 81 percent, of the construction activity would occur

within the Lower Mesilla and El Paso RMUs. Of the construction work that would occur in those two RMUs, about half of the work would occur within the El Paso RMU.

The construction duration for each proposed project, the roadways that would be affected during those time periods, and the estimated maximum number of daily worker vehicle trips and truck trips throughout the construction period are presented in Table 4.13-2.

Table 4.13-2 Construction Duration and Estimated Daily Vehicle Trips

Action	Affected Roadways	Construction Period (months)	Maximum Construction Worker Vehicle Trips (one-way)*	Average Truck Trips (one-way)*
New Levee (6 ft. height)	I 25, SH 185, SH 187 SH 154, SH 26, levee roads	16	144	76
Floodwall (Canutillo area)	I 10, SH 375, SH 20, levee roads	4.5	110	14
Raise levee (12 miles per year for 5 years)	I 25, SH 185, SH 187 SH 154, SH 26, SH 28, I 10, SH 478, SH 192, SH 228, SH 227, SH 226, SH 404, SH 225, SH 20, Vinton Rd., SH 375, levee roads	60	178	86

* Number of trips during the construction period

The maximum number of worker vehicle trips expected during the morning and evening commute hours and the average number of truck trips expected to arrive at and leave the construction sites throughout the work day are shown in Table 4.13-3.

Table 4.13-3 Expected Additional Traffic During the Construction Period

Action	Estimated Average Number of Vehicle[a] Trips Per Day	Average Number of Vehicle Trips During the a.m. and p.m. Commute Hours	Average Number of Vehicle Trips per Hour During the Remaining 6 Hours of Work
New Levee (6 ft. height)	130	65	0
Floodwall (Canutillo area)	99	50	0
Raise Levee (12 miles per year for 5 years)	160	80	0

Depending on the construction activities that are occurring at the time, the numbers in Table 4.13-3 could be higher or lower on any given day. Additionally, the majority of vehicle trips that would occur during the commute hours would be construction worker vehicles rather than semi-trucks.

As shown above, the increase in existing hourly traffic during the remaining 6-hour workday from project construction activities, which would consist solely of heavy construction equipment vehicles (dump trucks, flat-bed trailers, *etc*.), would be insignificant.

Table 4.13-4 presents the expected roadway LOS associated with the increased traffic levels during the project construction period. Construction vehicles associated with environmental measures within the floodway (such as erosion protection, sediment management.) would mostly access levee roadways and not the highways listed in Table 4.13-4. As shown in the table, the LOS of all roadways listed would not change from existing conditions, resulting in no significant effect on traffic flow from project construction.

This increased traffic would be an inconvenience to commuters traveling on these roadways during the morning commute (the project construction traffic in the evening would occur before the primary evening commute hour). This impact on traffic and circulation on the affected roadways would be temporary and not considered significant, only lasting during the construction period.

4.13.5 Integrated USIBWC Land Management Alternative

This alternative would include the same construction activities as the Flood Control Improvement Alternative. In addition to these construction activities, the Integrated USIBWC Land Management Alternative includes bank shavedowns, soil preparation, prescribed burning, regeneration of native woody vegetation, and improvement of erosion control. These activities cover over 2,000 acres and would occur entirely within USIBWC ROW. These activities would be compatible with and would not change existing land use.

The methodologies used to calculate traffic effect analysis for the Flood Control Improvement Alternative were used to estimate the traffic effects for the Integrated USIBWC Land Management Alternative.

Traffic levels for this alternative would not vary from the Flood Control Improvement Alternative. This alternative would generate the same effects; therefore, the LOS of all affected roadways would not change, resulting in no significant impact on traffic flow from project construction. Mitigation for this alternative would be the same as for the Flood Control Improvement Alternative.

4.13.6 Targeted River Restoration Alternative

In addition to flood control improvements and ROW habitat enhancement, the Targeted River Restoration Alternative would also utilize 1,618 acres outside the ROW for the establishment of voluntary conservation easements. Voluntary easements would be established for a vegetation management program. These areas would function to enhance the connectivity of riparian communities with upland areas and provide buffer zones for the protection of wildlife. Ownership of these properties would not change; only the function of the land through voluntary easements.

Table 4.13-4 Expected Increase in Existing Average Daily Traffic and Expected Level of Service During Construction

Action	Roadways Affected	Expected Level of Service (LOS)
New Levee (6 miles in 1 year)	I 25 SH 185 SH 187 SH 154 SH 26 Levee Roads	B B D A A NA
Floodwall (2.8 miles in 1 year)	I 10 SH 375 SH 20 Levee Roads	C A A NA
Raise Levee (12 miles per year for 5 years)	I 25 SH 185 SH 187 SH 154 SH 26 SH 28 I 10 SH 478 SH 192 SH 228 SH 227 SH 226 SH 404 SH 225 SH 20 Vinton Rd. SH 375 Levee Roads	B B D A A A C B A A A A A A A A C NA

The methodologies used to calculate traffic impact analysis for the Flood Control Improvement Alternative and the Integrated USIBWC Land Management Alternative were used to estimate the traffic effects for the Targeted River Restoration Alternative.

Traffic levels for this alternative would increase slightly from the Integrated USIBWC Land Management Alternative. This alternative would generate the same effects; therefore, the LOS of all affected roadways would not change, resulting in no significant impact on traffic flow from project construction. Mitigation for this alternative would be the same as for the Integrated USIBWC Land Management Alternative.

4.14 MITIGATION MEASURES

The USIBWC proposes to implement the following mitigation measures to offset or decrease the environmental effects of implementing the alternative actions. Most of these mitigations have been included in the project designs.

Mitigations are organized into two classes: 1) construction activities as a result of implementing environmental measures and levee rehabilitation; and 2) vegetation treatments used to control invasive species and establish desired vegetation. These mitigations are categorized by resource area.

4.14.1 Water Resources

Table 4.14-1 lists mitigations measures for protection of aquatic resources. Measures are applicable to construction activities, such as lowering of stream banks, and vegetation management for development of a riparian corridor.

Table 4.14-1 Mitigation Measures for Water Resources

Construction Activities
Water-C1. During construction near the river, best management practices and spill control procedures would be emplaced to prevent contamination and increased erosion to the river. Heavy equipment needing servicing (fueling, greasing, repair work) will be done out of the riparian zone. Fuel stored on-site will be in an upland position and in a cleared area with an earthen containment barrier.
Water-C2. Sediment would not be placed within the river during shavedowns and bank preparation, rather sediment would be moved to nearby floodway locations and stabilized by revegetation in conjunction with native grassland environmental measure. Design would promote backflow inundation reducing the possibility of sediment eroding and entering the river.
Water-C3. Bank shavedowns point projects and other locations inundated by peak flows would be design to promote backflow inundation thereby reducing the possibility of sediment entering the river. In sites where backflow inundation is not feasible, erosion controls would be put in place to limit the amount of sediment entering the river while still providing conditions suitable for native species germination.
Water-C4. The USIBWC would create an accounting system that would identify the location(s) and quantity(ies) of water removed from the river, the amount returned to the river as a result of environmental measures.
Water-C5. Removal of invasive salt cedar would reduce water consumption.
Vegetation Treatments
Water-V1. Herbicide would be applied directly to targeted plants in a manner to minimize runoff to surface water
Water-V2 Herbicides will not be aerially applied over open water.
Water-V3 Prescribed burns would incorporate BMPs to limit runoff into the river.
Water-V4 Mechanical removal of salt cedar during maintenance or fuel reduction would not be conducted on the river margin; rather material would be cut and removed manually. Avoidance of the river bank by equipment would reduce sediment input into the river.
Water-V5. – Woody debris as a result of salt cedar reduction will be burned or removed from the floodway.

4.14.2 Flood Control and Soil Excavation

Table 4.14-2 lists mitigations measures for flood control and soil excavation. Measures are applicable to construction activities, such as lowering of stream banks, and vegetation management for development of a riparian corridor.

Table 4.14-2 Mitigation Measures for Flood Control and Soil Excavation

Construction Activities
Flood – C1. Conservation easements in Rincon Valley and Seldon Canyon would be used within locations potentially effected by controlled releases. Controlled releases would be gradual and incremental in order to monitor the predicted extent of over bank flows.
Flood – C2. Sediment removed as a result of implementing environmental measures would be placed in the floodway (no net change in the RGCP flood containtment capacity.
Soils-C1. Construction during and after arroyo embankment creation, and opening former meanders will expose unprotected soil to rainfall runoff and wind erosion. USIBWC would consider performing construction during the dry season to limit exposure to rain.
Soils-C2. Bank shavedowns exposed to frequent high water velocities would be susceptible to erosion. When bank shavedown areas are located on the outer bend of the river, a river diversion barrier parallel to the river and between the bank shavedown area and the river will slow river course migration. River water should enter bank shavedown areas from a downstream section opening (back flooding). A drainage channel placed length-wise through the bank shavedown area, possibly below river elevation, will minimize erosion by limiting the runoff distance when the river recedes. This construction method will create a habitat similar to only opening a former meander to the river on the downstream end.
Soils-C3. Temporary materials and equipment-staging areas at the water diversion facility construction area would be reclaimed and revegetated with suitable native woody trees and shrubs.
Vegetation Treatments
Soils-V1. The heavy equipment used for brush reduction would be wheeled and not tracked.
Soils-V2. Oversized wheels would be used to minimize soil compaction and rutting.
Soils-V3. Mechanical treatment would be conducted in the late summer and fall, which typically provide for dryer soil conditions, which would minimize soil displacement and compaction.
Soils-V4. Signage will indicate that riparian use is limited to designated trails and explaining that the purpose is to limit erosion, minimize damage to vegetation, and provide refuge areas away from trails where wildlife remain undisturbed.

4.14.3 Biological Resources

Table 4.14-3 lists mitigations measures for biological resources. Measures are applicable to construction activities, such as lowering of stream banks, and vegetation management.

Table 4.14-3 Mitigation Measures for Biological Resources

Construction Activities
Vegetation-C1 Temporary materials- and equipment-staging areas at construction areas would be reclaimed and revegetated with suitable native woody trees and shrubs
Vegetation-C3. The USIBWC would restore riparian vegetation in the areas temporarily affected by the levee rehabilitation
Vegetation-C4. The USIBWC would monitor all environmental measures.
Vegetation-C5. Studies would need to be performed in order to determine locations and specific details for some of the bosque improvements, including: fire prevention through fuel reduction (assess fuel loads and priority areas), bank lowering (determine where low banks exist), channel cutting (determine locations in terrace to promote a better connection between the channel and floodplain), and removal of invasive species (determine areas of most invasion and priority areas)
Aquatic-C1. During construction near the river, best management practices and spill control procedures will be emplaced to prevent contamination and increased erosion to the river.
Aquatic-C2. When equipment is operating in the river, or arroyo tributaries, if fish are stranded, they will be salvaged and put into the main river channel.
Aquatic-C3. During construction in the river, the USIBWC would use BMPs to minimize and contain the discharge of suspended sediments into the Rio Grande.
Vegetation Treatments
Vegetation-V1. Garlan-4® herbicide or equivalent would be sprayed by hand application to targeted species whenever feasible.
Vegetation-V2. Vegetation will be monitored (species, composition, abundance and distribution) before and after vegetation treatments.
Vegetation-V3. Re-vegetate the upland disturbed areas with native species
Vegetation-V4. Herbicides would not be aerially applied on areas where sensitive riparian vegetation such as cottonwoods and willows are extensively intermingled with the salt cedar.
Vegetation-V5. Protect revegetation sites for at least one growing season from grazing
Vegetation-V6. Prescribed burns would be conducted in accordance to techniques identified in a RGCP River Management Plan. The Plan will be developed by the USIBWC with guidance from resource agencies including the USFWS, BLM and state agencies.
Vegetation-V7. Planting would be conducted in accordance to techniques identified in a RGCP River Management Plan. Plantings would be conducted using native species.
Vegetation-V8. Degraded or burned areas would be interseeded with native grasses and forbs to further enhance the establishment of desirable browse and forage species. Seeding will be conducted in accordance to techniques identified in a RGCP River Management Plan.
Vegetation-V9. Saturated and ponded areas would be avoided during mechanical and chemical treatments.
Vegetation-V10. Burning would need to occur when woody plants such as salt cedar are not actively seeding, as burning would create open spaces for seedling establishment of salt cedar. If there are woody plants present on the areas considered for burning, these species would have to be assessed for fire-tolerance. Salt cedar tends to be more tolerant of fire than some native riparian species.
Wildlife-V1. Treatments would occur outside the nesting season, which is generally March through August. If construction activity must occur during the migratory bird-nesting season, surveys would be conducted and active nests would be marked and avoided.
Wildlife-V2. USIBWC will develop a Fire Management Plan as part of the RGCP River Management Plan. The Fire Management Plan will detail perceived burn methods and BMPs to offset any potential negative effects to wildlife as a result of treatments.
T&E Species-V1. Wherever possible, treatments would not be used in known habitats of listed or sensitive species.
T&E Species V2. Where treatments would be necessary in proximity to known listed or sensitive species' habitats, the treatment would be selected to minimize the effect.
Aquatic Biota-V1. Herbicide would be applied directly to targeted plants in a manner to minimize runoff to surface water.
Aquatic Biota-V2 Herbicides will not be aerially applied over open water.

4.14.4 Land Use, Socioeconomics and Cultural Resources

Table 4.14-4 lists mitigations measures for land use, socioeconomics and cultural resources. Measures are applicable to construction activities, such as lowering of stream banks, and vegetation management for development of a riparian corridor.

Table 4.14-4 Mitigation Measures for Land Use, Socioeconomics and Cultural Resources

Construction Activities
Land Use-C1. The USIBWC would adhere to project work-hour restrictions (work allowed only between 7 a.m. and 10 p.m.) within 500 feet of residences, hospitals, and schools.
Soc-C1 Existing road and utility rights-of-way would be used as much as possible to reduce permitting and land- acquisitions cost and to reduce disruptions to commercial facilities.
Soc-C2 Where possible local construction personnel would be hired to build the project.
Soc-C3 Local professional or service personnel would be hired and trained to operate and maintain facilities so direct and secondary spending remains in the local economy.
Cultural-C1. A cultural resources discovery plan would be prepared and make final through consultation with the SHPO prior to the beginning of construction.
Cultural-C2. Precautions would be taken to ensure that archaeological assistance is promptly available in case of a discovery. The discovery plan approved by the SHPO would detail these measures.
Cultural-C3. Before ground-disturbing construction work takes place, a preconstruction conference would be held with construction crews to inform them of the potential for disturbing subsurface cultural resources, and the procedures involved in the event that this occurs.
Cultural-C4. Any cultural resources found during construction would be documented and evaluated as to their eligibility for listing on the National Register of Historic Places.
Vegetation Treatments
Land Use-V1 Herbicides would not be aerially applied in populated areas or within 500 feet of residence.
Land Use-V2 – Prior to any treatments, notices and signage will be placed to assure any nearby communities are aware of upcoming treatments.
Cultural-V1. Treatments would avoid deep soil disturbance (i.e. root plowing) whenever possible. In the event, deep soil treatments are required, mitigation measures for construction activities would be used.

4.14.5 Air, Noise and Transportation

Table 4.14-5 lists mitigations measures for for air, noise and trasportation. Measures are applicable to construction activities, such as lowering of stream banks, and vegetation management for development of a riparian corridor.

Table 4.14-5 Mitigation Measures for Air, Noise and Transportation

Construction Activities
Air-C1. Dust control measures are applicable to any construction site where dust is created and there is the potential for air and water pollution from dust traveling across the landscape or through the air. Dust control measures are particularly important in arid or semiarid regions, where soil can become extremely dry and vulnerable to transport by high winds. Dust control measures include sprinkling/irrigation, mulch, vegetative cover, and wind breaks.
Air-C2. Each construction contractor would be responsible for assuring that construction equipment (especially diesel equipment) meets local community opacity standards for operating emissions.
Air-C3 Each construction contractor would acquire excavation, grading, and surface-disturbance permits that specify BMPs to minimize particulate and dust emissions from construction work sites.
Air-C4 Mitigation would ensure that mechanized equipment is in good operating condition so that exhaust emissions are kept to a minimum.
Noise-C1. Each contractor would adhere to project work hour restrictions (work allowed only between 7 a.m. and 10 p.m.) within 500 feet of residences, hospitals, schools, churches, and libraries. Each contractor would arrange the construction schedule to restrict to 4 the number of days in one work location within 500 feet of the same residence, hospital, school, church, or library.
Traffic C-1. Develop and implement traffic protocols and travel routes for all project construction trucks, vehicles, and equipment, including measures for ingress, egress, turning, and back-up movements at all proposed facility sites.
Vegetation Treatments
Air-V1. The amount of vapors would be minimized by dispensing herbicide in a vegetable oil solution limiting airborne particulates. Application of this treatment would not occur during high-wind conditions.
Air-V2. Use smoke management techniques that rely on computer models to determine smoke dispersion prior to prescribed burns.
Air-V3. Use guidelines established by the National Weather Service; a clearing index of 500 or greater would be required for prescribed burning.

4.15 CUMULATIVE EFFECTS

Cumulative effects are defined as impacts on the environment that result from the incremental impact of the action when added to other past, present and reasonable foreseeable future actions. It does not matter what agency or person undertakes these actions. Cumulative effects can result from individually minor, but collectively significant actions taking place over time.

Several projects and activities are planned or being implemented along the RGCP that would likely have some potential for cumulative impact. This section describes those activities that could contribute to cumulative impacts when combined with environmental measures being implemented within the RGCP. Cumulative effects are described for those resource areas where such effects would reasonably occur. These activities and projects are described below.

4.15.1 Regional Plans

El Paso-Las Cruces Regional Sustainable Water Project

The New Mexico-Texas Water Commission proposed securing future drinking water supplies from surface water sources for the El Paso-Las Cruces region through the construction and operation of water treatment plants, aqueducts and diversion structures, aquifer storage and recovery, water acquisitions, water conservation, and water banking. This project is known as the El Paso-Las Cruces Regional Sustainable Water Project. The USIBWC and El Paso Water Utilities/Public Service Board (EPWU/PSB) were co-lead agencies for project planning and evaluation of potential effects. The project has not entered the implementation phase as agreements have not been reached on water acquisition. The City of El Paso has developed plans for use of groundwater treated by desalination.

Cumulative impacts would have been significant for all resource areas. However, it appears that this project is no longer viable.

Upper Rio Grande Basin Water Operations

A multi-agency task force is currently evaluating more reliable and effective management strategies for the Upper Rio Grande basin through comprehensive hydraulic and hydrological simulation of stream flows, storage, and water demands. Timing of flows through the RGCP, as well as potential controlled releases from Caballo Dam, could be influenced by findings of the operations evaluation. As part of an ongoing Environmental Impact Statement, draft alternatives are currently under development for the Upper Rio Grande Basin Water Operations.

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This project could likely improve delivery efficiency which could insure potential water availability for measure implementation.

4.15.2 Analysis of Structural Condition of the Levees

The need for levee rehabilitation due to structural deficiencies is not currently known. The extent of such rehabilitation would be dependent on findings of an ongoing investigation to verify levee condition. The three-step investigation entails aerial geophysical surveys, followed by surface geophysical surveys, and a geotechnical drilling program. The goal of aerial geophysical surveys is to identify the regions of levee that yield questionable electrical conductivity values as related to soil composition. Resulting electrical conductivity values would then be correlated to known soil properties and

characteristics, thus providing a regional representation of levee composition (i.e., sand, clay, voids).

Levee regions identified in the aerial geophysical surveys as questionable or inappropriate for flood control purposes would be re-surveyed using surface geophysics methods. Surface geophysical surveys would generate detailed resistivity/conductivity data to more accurately quantify integrity of the levee. Results of the surface geophysical survey would determine the sites that require geotechnical investigations (i.e., analysis of soil borings). Combined results of the geophysical and geotechnical drilling program would conclude where levees must be completely replaced (using new material) or rehabilitated (replace some material and re-compact). The USIBWC plans to complete the geotechnical investigations during the Fiscal Year 2004.

If this study shows additional levee deficiencies requiring major construction to correct problems cumulative impacts could result in air quality, soils, cultural, transportation, noise and socioeconomics. Construction could result in possible ground disturbance to archaeological sites in barrow areas and at sites near new levee construction. Additional impacts to noise, transportation and air would be dependent on the amount of new construction. In this EIS the potential effects of levee rehabilitation have been examined under the Flood Control Improvement Alternative.

4.16 UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts are environmental consequences of an action that cannot be avoided either by changing the nature of the action or through mitigation if the action is undertaken. Unavoidable environmental effects would result from implementation of the alternative actions; however, none of the effects would be significant.

The sediment removal activities would have short term unavoidable adverse effects on biological and fisheries resources. However, in the long term biological communities would flourish due to alternative actions. The impact to benthic invertebrates would be localized and not likely effect area populations. Loss of water due to the creation of wetlands and bosque enhancement areas would have a small effect on commercial farming and land use.

4.17 RELATIONSHIP BETWEEN THE SHORT-TERM USE OF THE ENVIRONMENT AND LONG-TERM PRODUCTIVITY

This analysis investigates the relationship between short-term uses of the environment and the maintenance and possible enhancement of long-term productivity. Improving and adding levees would provide value in improved flood control and water deliveries. Soil would be displaced as a result of bank shave-downs or opening former meanders, excavating arroyos, and scour during seasonal peak flows; however, soil would be deposited within the floodway or on the levee toe and slope as a beneficial use. Restoration of native bosque and development of native grasslands in formally mowed areas would result in direct beneficial effects for environmental improvements. Seasonal

peak flows, opening meanders and incorporation of conservation easements would significantly increase the amount of native bosque and native grasslands. There would be no disruptions of short-term uses of the river or known effects on long-term productivity within the river.

4.18 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Irreversible and irretrievable resource commitments are related to the use of nonrenewable resources and the effects the use of these resources would have on consumption or destruction of a resource that could not be replaced in a reasonable period of time. The irreversible environmental changes that could result from implementation of the alternative actions include consumption of material resources, energy resources, and human resources.

Material resources used for the alternative actions include building materials for construction of levees or levee improvements, new floodwalls, or tree planting. The materials that would be consumed are not in short supply and are readily available from suppliers in the region. Use of these materials would not limit other unrelated construction activities and, therefore, would not be considered significant.

Energy resources would be irretrievably lost. These include petroleum-based products such as gasoline and diesel fuel. During construction or dredging activities, gasoline and diesel fuel would be used for operation of equipment and other vehicles. Consumption of these energy resources would not place a significant demand on their availability in the region. Therefore, no adverse impacts would be expected.

The use of human resources for construction or dredging activities is considered an irretrievable loss, only in that it would preclude such personnel from engaging in other work activities. However, the use of human resources for the alternative actions represents employment opportunities and is considered beneficial.